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The Australian and New Zealand
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COARCTATION OF THE AORTA

By JOHN HAYWARD

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THIS paper is based on the work of ten Australasian surgeons each of whom has furnished the results of all the patients with coarctation of the aorta on whom he has operated.

A total of 93 cases was explored. Three were inoperable and the remaining 90 patients had their coarctation resected. In 81, direct end-to-end anastomosis of the aorta was performed after the resection. Two had subclavian aortic anastomosis and, in the remaining seven, aortic continuity was restored by the insertion of a preserved aortic homograft. There were eight operative deaths (9 per cent.).

Eighty-nine of the resected cases were of the adult type. Only one was of the infantile type with a patent ductus opening distal to the coarctation. In all, the coarctation was in the usual position. No coarctation in the lower thoracic aorta or in the abdominal aorta seems to have been found in this part of the world. This is surprising, because Sloan *et alii* (1953) found four cases of coarctation at an unusual site among 125 surgically confirmed cases.

The distribution of cases among individual surgeons is of some interest (Table 1).

The three largest series are all from four surgeons in one city (76 cases). The remaining 14 cases are all that are reported from the rest of Australia and New Zealand. It is known that other cases have been operated on by two or three other surgeons who have not submitted their figures, but they are few; and the surgeons who have co-operated report that they have seldom refused to operate on patients referred to them except, in young children, to wait for a more suitable age. If Burford's (1950) figure of 1 per 1,000 births is correct for the incidence of coarctation, in our total population of about ten million there must be many other patients with the anomaly who have not been sent to a surgeon. Presumably over a wide area of this country there are general practitioners and physicians who either fail to diagnose the condition or who disapprove of its surgical correction.

AGE AND THE INDICATIONS FOR OPERATION

Every patient diagnosed with aortic coarctation which appears resectable should be

TABLE 1

DISTRIBUTION OF CASES AMONG INDIVIDUAL SURGEONS

										Total
Surgeon	47*	15	14	5	4	2	1	1	1	90
Mortality	3	1	3	0	0	0	1	0	0	8

*Combined figures of two surgeons.

considered for operation. The age of the patient at the time of diagnosis has an important bearing here, and the problem of the proper relation between age and resection has exercised physicians and surgeons all over the world without the emergence of uniformity of opinion.

Gross (1949) states that it is wise to avoid operation before 6 or 8 years of age unless there are specific reasons for earlier intervention, because the lumen provided at operation may become insufficient as the child grows to maturity, and the risks of operation in very young children may be higher because the collateral channels may not yet be well developed. Clagett *et alii* (1951) regard between 15 and 20 years as the best age for operation but Bahnson (1952) writes that between 6 and 15 years is the best and Sealy (1953) states that the technical advantages between 5 and 10 years outweigh any consideration of further growth at the anastomotic site.

Though the operation is undoubtedly easiest to do in late childhood, our figures summarized in decades (Table 2) reveal the interesting observation that, at least in our hands, the risk of operation does not increase with age. Obviously technical difficulties can be overcome and the surgeon should not operate in childhood because it is easier if the child would be better left till he is older.

TABLE 2

Age at operation	0–9	10–19	20–29	30–39	40–49	*Total*
Number of cases	18	40	25	8	2	93
Operative deaths	1	4	2	1	0	8

The atheroma which develops in cases of coarctation is well known to increase with age but it is seldom severe enough to cause technical difficulties before the age of 20 years and, in my experience with older patients, it is far from proportional to their age. My worst patient was a woman aged 29 who was operated on before grafts were available. Her aortic wall at the site of section was hopelessly friable and tore with every stitch; she died on the table. Another, aged 40, with a blood pressure in the arms of 230/140 mm. Hg. and a pre-operative cerebral vascular accident, had an elastic aorta with very little atheroma at the site of section and the anastomosis was easy. The possible technical difficulties in older patients should not be feared, but faced. With modern instruments and materials for grafts, if necessary, there will be few aortic walls which cannot be successfully anastomosed by a surgeon skilled in vascular work. In short, the variation with age in the technical difficulties of the operation should not be made an important factor influencing the decision for or against operation, or in choosing the time when it should be done.

The relation of age to the indication for resection of a coarctation may be summarized as follows:

(a) *Patients without symptoms*

(1) Children without symptoms are probably best left till adolescence. The best time is shortly after the pubertal period of rapid growth.

(2) Adolescents, and adults up to the age of about 30, should be operated on.

(3) The further a patient goes beyond the age of 30 without symptoms, the more likely he is to belong to the 26 per cent. (Riefenstein *et alii*, 1947) who will die of other causes and not of the coarctation or its effects. The indication for operation therefore lessens rapidly with advancing years in symptomless patients over 30.

(b) *Patients with symptoms*

(1) Infants.

Infants are not represented in our series of operations, but one of us reports that two infants aged 2-3 months have died in his hospital without operation and a third has recently, with medical treatment, survived a period of cardiac failure and seems to have become adjusted. There is difference of

opinion, in the literature, concerning the management of such babies. Gross (1949) states that most babies with large hearts and congestive cardiac failure can be managed medically and improve in a few months, so that it is better to wait until they are older. Baronofsky *et alii* (1954) advise operation in the small group of babies under one year of age who have an aortic block and uncontrollable cardiac embarrassment. They describe a successful operation in a two weeks old baby with the infantile type of coarctation. de Groot *et alii* (1953) urge early operation in the infantile type and in the adult type with a patent ductus. They state that these cases usually present with heart failure and that they should be operated on as soon as the heart failure is relieved with digitalis and oxygen.

Perhaps the best advice is to operate early on all infants with coarctation and heart failure if the heart failure is not readily relieved by medical treatment.

(2) Children with symptoms or with appreciable cardiac enlargement (Sealy, 1953) should be operated on.

(3) All adolescents and adults at least up to the age of 45 with symptoms require operation if there are no other contraindications. In middle age the possibility of irreversible arterial disease, especially in the aorta and cerebral arteries, is increased and the improvement to be expected after operation correspondingly diminished.

Associated Cardiovascular Lesions and the Indications for Operation

(1) *Vascular lesions*

In this series there were 7 patients with patent ductus arteriosus; 2 of the ductuses were distal to the coarctation (infantile type). One of the last also had an aortopulmonary septal defect; this was one of the three inoperable cases. Two had a persistent left superior vena cava which did not interfere with the operation and one had a right subclavian artery arising just distal to the coarctation, passing upwards and to the right behind the oesophagus. There were no ordinary aneurysms of the adjacent aorta or intercostal arteries but one had a mycotic aneurysm near the coarctation.

None of these associated vascular anomalies is a contraindication to operation and a persistent patent ductus arteriosus is a strong indication for it.

(2) *Cardiac lesions*

Four ventricular septal defects and one atrial septal defect were diagnosed in this series. The diagnoses appear to have been made on clinical grounds except in one patient who died subsequently of subacute bacterial endocarditis at the site of his ventricular septal defect. We have had no cases of fibroelastosis of the endocardium (Oppenheimer, 1953; de Groot *et alii*, 1953). All reported cases of this associated anomaly have been fatal.

The valvular lesions diagnosed were eight cases with aortic regurgitation and three with aortic stenosis. One patient had a mitral mid-diastolic murmur which may have been due to mitral stenosis.

Seven of the 8 patients with aortic regurgitation were much improved by resection of their coarctation but the eighth, a man aged 32 with a very large heart and greatly diminished exercise tolerance, died of left ventricular failure on the fourth day after a technically satisfactory resection and replacement with a graft. Two of the 3 patients with aortic stenosis died suddenly about 18 months after the operation for the coarctation; both were females, one aged 7 and one 28. In the latter the aortic valve was grossly calcified and, at post-mortem, both showed perfect healing of the anastomotic site with a full aortic lumen.

Concerning the correct attitude to valvular disease associated with coarctation there is the usual difference of opinion in the literature, reflecting our very imperfect understanding of the disease. Sealy (1953) states that the combination of coarctation of the aorta and some other anomaly of the heart or great vessels constitutes the strongest indication for surgery and that the removal of the coarctation will improve the cardiac function. On the other hand, Jacobson *et alii* (1953) consider that, in the presence of congenital mitral stenosis, subaortic stenosis or aortic stenosis with calcification and a bicuspid aortic valve, operation for coarctation is contraindicated. Edwards, discussing the report of Kroeker *et alii* (1954) of a

successful resection of coarctation in a patient with associated subaortic stenosis, regards associated valvular disease as a potential hazard to the patient undergoing resection, and says that present knowledge precludes the determination of which patients with associated valvular disease will, and which will not, respond satisfactorily to surgical correction of the coarctation.

The experience in this series of cases suggests that associated aortic stenosis or severe aortic regurgitation makes resection of the coarctation dangerous and of doubtful value, but that an aortic diastolic murmur without any great enlargement of the left ventricle is no bar to a good result of resection.

Other associated or complicating factors

A previous cerebral vascular accident does not contraindicate operation providing the patient has recovered sufficiently to make it worth while; but a successful operation does not promise absence of further such accidents, though presumably it makes them less likely.

Pregnancy probably increases the risk of aortic dissection and rupture (Furman *et alii*, 1952). Benham (1949) found that in 53 pregnant women with coarctation 36 were unaffected by the pregnancy but in 11 the symptoms were precipitated or increased and 6 died during the pregnancy. It is probably best to operate on the coarctation, if the patient is seen early enough (Miller and Falor, 1952), during the second trimester. If not, the patient should proceed to term and have a Caesarean section before labour begins. She should not be sterilized if the coarctation is operable. Resection of the coarctation should follow after a suitable interval.

There was no operation during pregnancy in this series but one young woman unfortunately had her pregnancy terminated just before she was referred to the surgeon. Her coarctation was resected and replaced by a graft and she went through a normal pregnancy and labour, giving birth to a son 11 months after the operation.

One case in this series, a girl aged 19, also had severe diabetes and chronic nephritis. In the year preceding operation she had had repeated retinal haemorrhages and was nearly blind. It was thought that if her blood pressure could be reduced by resection of the coarctation the retinal haemorrhages might cease; so the operation was performed two years ago. She has had no further retinal haemorrhages and her eyesight has improved slightly. She has since married.

The post-operative blood pressure

After satisfactory resection of a coarctation the blood pressure in the arms occasionally falls to normal almost at once. More usually it takes two to three weeks and, in an appreciable number, it is still well above normal though less than pre-operatively, two months or more later. These observations have also been made and reported by others.

Brock (1953) reports that, for success in a coarctation operation, it is usually stated that the anastomotic lumen must be at least 60 per cent. of the normal aortic lumen and goes on to describe a case in which the anastomotic lumen was no less than 60 per cent. yet the blood pressure was no lower. He does not say for how long after the operation the blood pressure was followed but he regards the case as a failure. Though the more nearly the anastomotic lumen approaches normal aortic size the more likely is the blood pressure to fall to normal, this is by no means the only factor influencing the fall. Indeed, the behaviour of the circulation after resection of a coarctation is not understood.

Bahnson (1952) observed that the blood pressure often remained up for 10 to 14 days and occasionally, for no apparent reason, for several months. Hallenbeck *et alii* (1951) found that occasionally the clinical result and the blood pressure readings did not run parallel and that both tended to improve for one to two years, retrogression being rare. Gerbode (1955) observed that complete restoration to normal blood pressure often did not occur with even a large direct anastomosis in the older age group and Glenn *et alii* (1952) reported the case of a female aged 40 in whom headaches were relieved and there was a good rise of blood pressure in the legs but the arm pressures only changed from 190/100 to 170/130 mm. Hg. in two months. From this they concluded that irreversible changes had prevented the arm pressures from falling and that the operation had been done too late.

In this connection the following personal case deserves comment. The patient was aged 40 at the time of operation, and suffered from crippling headaches. She had also had one cerebral vascular accident. Her pre-operative blood pressure in the arms was 240/130 mm. Hg. After the operation it was 180/120 in two weeks, 210/110 in three months, 180/100 in eight months, and 155/95 mm. Hg. in fourteen months. Her headaches were rare and never severe after the operation, and they disappeared altogether within eight months.

I cannot explain her blood pressure changes but I think that they indicate the error of assuming that, when the blood pressure is not down to normal within two months, vascular changes are irreversible. They also show that it is unwise to judge the success or failure of the operation on blood pressure readings taken a short time afterwards. If the anastomosis has been technically satisfactory, and the blood pressure in the legs taken with the ordinary sphygmomanometer is at once higher than in the arms and remains higher, the likelihood is that the arm blood pressure will fall sooner or later unless the patient has some other disease causing hypertension, and that the result of the operation will be good.

In this series 60 per cent. to 70 per cent. of the cases surviving the operation had blood pressures described as normal but, as in other series, these figures are not of much value since they were recorded at varying post-operative intervals which were not stated. However, all those with pre-operative symptoms were relieved or improved. Only one patient, a boy aged 17, has retrogressed. His direct anastomosis appeared perfectly satisfactory at operation and his blood pressure fell from 230/130 to 160/95 mm. Hg. for three months. Then it gradually rose over two and a half years to its present figure of 210/120 mm. Hg. His surgeon does not report the present blood pressure in his legs.

Details of the eight operative deaths

Two patients died of haemorrhage due to technical difficulties. One, already mentioned, died on the table because the aorta was repeatedly torn by the sutures. The other died because of a torn right intercostal which was never properly found and ligated. Two hours were spent controlling it and the operation was completed, but he bled post-operatively. His clotted haemothorax was evacuated on the fifth day but he died shortly afterwards.

Three patients died of post-operative arterial infection. Two were proved due to *Staphylococcus aureus*, and in the third a coccus was seen in sections but was not cultured. It was probably the same organism.

In two of these cases the infection caused rupture of the anastomosis two to three weeks later. In one of them the surgeon oversewed the suture line, resected it again and re-anastomosed the aorta and finally resected it a second time and inserted a graft. The patient died of ventricular fibrillation at the conclusion of the sixth thoracotomy, having survived one hour of cardiac arrest. There was no evidence of infection in the resected coarctation but the anastomosis which was resected before the second resuture showed vegetations containing cocci which also extended out into the adventitia. Such valiant persistence deserved a better result but apparently success is most unlikely once infection resistant to chemotherapy is established. Infection of coarctation operations with the drug resistant Staphylococci, which are becoming prevalent in modern hospitals, is evidently a very serious matter.

The anastomosis was intact in the third case of post-operative arterial infection. The patient died of massive haemorrhage on the 17th day and, at autopsy, the haemorrhage was found in the retroperitoneal tissues and mesentery. There was also a large haemothorax, the source of which could not be determined. Two somewhat similar cases of necrotizing panarteritis following resection of coarctation are reported by Lober *et alii* (1954). Both developed small bowel necrosis needing resection; one survived. In the other, lesions indistinguishable from polyarteritis nodosa were found at autopsy, confined to arteries supplied by the aorta below the coarctation.

One of our fatal cases had endocarditis with congestive cardiac failure and panarteritis with mycotic aneurysms at the time of operation. Cardiac arrest occurred during the operation and the heart beat was restored,

but the patient died shortly afterwards. Another patient, mentioned earlier in this paper, had severe aortic regurgitation and died of left ventricular failure. The final death was due to respiratory failure two hours after operation in a child who also had gross bilateral bronchiectasis. The intention had been to operate on the bronchiectasis after recovery from resection of the coarctation; perhaps the lobectomies should have been done first.

OPERATIVE PROBLEMS

There are questions which frequently arise during the resection of a coarctation and two are worthy of discussion.

(1) *For how long is it safe to clamp the left subclavian artery?*

As aortic anastomosis takes a considerable time, there has always been doubt about the adequacy of the circulation to the lower part of the body, particularly the spinal cord, while it is being done. The thoracotomy incision destroys many of the collateral channels and, during dissection of the coarctation, though it used to be considered wise to preserve as many of the adjacent intercostal arteries as possible, most surgeons now divide them without hesitation until there is a clear field for the anastomosis. Is it safe, in addition, to clamp the left subclavian so that only the right subclavian remains to supply the lower part of the body?

Unfortunately, in many cases of coarctation the portion of the aorta above the point of extreme narrowing is too small right up to the left subclavian, so that laterally the anastomosis must be made to the lateral part of the wall of the left subclavian at its origin. A clamp can be placed across the aorta and the origin of the left subclavian leaving a narrowed pathway into this vessel above it and this is desirable when possible, but it sometimes leaves too small a cuff below the clamp for comfortable anastomosis. In such cases the clamp can be raised to occlude both vessels, or each can be clamped separately, the aortic clamp being placed between the left common carotid and left subclavian. I have done this on several occasions without any untoward effects. In one early case I was so disgusted with a badly matched anastomosis which leaked abominably that, having re-applied the clamps, I went away and had a cup of tea and returned refreshed to unpick the anastomosis and do it again. The clamps were applied to this patient's aorta and left subclavian for three hours; but he made a perfect recovery.

However, Beattie *et alii* (1953) report a case of post-operative paraplegia which they attributed to clamping the left subclavian for 38 minutes and then again for another 3 to 4 minutes; they refer to a similar case (Bing *et alii*, 1948) after subclavian aortic anastomosis. One wonders what the blood pressure was in the right subclavian in these cases during the period when the left subclavian was clamped.

Lowering the blood pressure with hypotensive drugs during the anastomosis makes it easier to do, but this may be unwise if the left subclavian is completely occluded at the same time. I have not used hypotension when I have clamped the left subclavian.

(2) *When should a graft be used?*

In some cases the length and degree of aortic narrowing make it obvious that a graft is essential. In others it is equally obvious that a full lumen can be obtained by direct anastomosis; but there are intermediate cases in which it can be seen that a lumen of about two-thirds normal aortic diameter can be obtained without a graft. The question then arises whether it is better to be satisfied with such a lumen or to aim at anatomical perfection with a graft. There are many patients, operated on before Gross (1951) introduced the use of grafts, who have a smallish anastomotic lumen but who are still well; unfortunately we do not know the minimum lumen adequate for a normal long life.

In a recent study of the fate of aortic homografts in dogs, Coleman *et alii* (1955) have shown that, over a period up to four and a half years, though all functioned well and no aneurysms formed, the grafts thinned greatly, tended to calcify, and always showed gross degeneration of their elastic fibres whether they were fresh or stored and regardless of the method of storage. They also found that plastic cloth grafts, such as Vinyon-N, Orlon, Dacron and Nylon, though giving encouraging functional success, could calcify below the new intima. They wonder, too, whether the plastic filament might be destroyed after a long time by depolymerization or other significant chemical change; and they note that some of these plastics can

cause sarcoma in a susceptible strain of rat. They conclude by urging vascular surgeons to employ vessel replacements only when absolutely vital to the success of the operation.

Most surgeons would agree with this and it is probably best to avoid a graft if a lumen of two-thirds normal or more can be obtained by direct anastomosis.

With enthusiasm for grafts beginning to wane, it is interesting to note the recent revival of the use of the left subclavian artery, not as a by-pass as originally suggested by Blalock, but as the direct channel to the lower aorta instead of a graft. The difficulty is that the subclavian vessel has to be turned through 180° to point downwards; but it must not be kinked. If kinking occurs it can be overcome by Schumacher's (1951) reversed bend technique. Another requirement is that the left subclavian should be at least nearly as large as the descending aorta. Gerbode (1955) reports two successful cases in which a large left subclavian was used in this way, thereby avoiding the necessity for a graft.

In several operations for coarctation I have noticed that the diameter of the aortic arch between the left common carotid and left subclavian was less than normal. This part of the arch is worthy of careful inspection during the dissection of a coarctation because, if it is narrowed, it is doubtful if there is any use making the anastomotic lumen larger, and in some cases resection of a length of coarcted aorta which would require a graft may not be necessary to obtain an opening big enough to match the narrow part of the arch.

SUMMARY

A series of 93 operations for coarctation of the aorta by ten Australasian surgeons is reported. Three cases were found to be inoperable and 90 were resected with a mortality of 9 per cent.

The indications for operation are discussed, particularly in relation to the age of the patient and the presence of associated cardiovascular lesions.

The post-operative changes in blood pressure are described, and the fallacy of judging the result of the operation by blood pressure readings taken shortly afterwards is stressed.

The deaths are analyzed, with special reference to 3 which were due to post-operative arteritis.

The questions of how long the left subclavian artery may be safely occluded and when to use a graft are discussed.

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MITRAL STENOSIS

By HARRY M. WINDSOR

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THE material for this presentation has been obtained through the courtesy and co-operation of thoracic surgeons in thirteen hospitals in Australia and New Zealand.

The general statistics are presented in Table 1.

TABLE 1

GENERAL STATISTICS — 641 CASES

Operations	*Female*	*Male*	*Youngest*	*Oldest*	*Average Age*
643	509	132	11 years	59 years	37 years

There are three points of particular interest in these figures:

(a) Only two patients were operated upon twice and of these only one had a second commissurotomy.

(b) The sex ratio of one male to five females corresponds with a similar ratio in most large published series.

(c) The youngest patient to be operated upon was eleven years of age.

SURGICAL DIFFICULTIES

The subject is best opened in the words of the man who introduced the operation. On 6th May, 1925, Souttar operated upon a girl of nineteen years. He said, "The method of digital exploration and fracture through the auricular appendage cannot be surpassed for simplicity and directness, the accuracy and precision of the information obtained was remarkable, the facility and safety of the procedure impressed all." With this background, then, the surgical difficulties will first be discussed.

(1) *Thrombosed atrium*

Thrombosis of the atrium presents the major surgical difficulty. It occurs as either an organized thrombus, a soft thrombus, or a combination of both.

The presence of organized thrombus in the atrium modifies to a large extent the method which is used to enter the cavity of the atrium. In the uncomplicated atrial cavity entry is usually achieved with ease. A clamp is placed across the base of the atrial appendage an incision is made into the appendage distal to the clamp. The finger is inserted as the clamp is removed and the valvotomy performed. At the completion of the valvotomy the clamp is replaced as the finger is removed.

In the thrombosed atrium, the atrial wall is flattened and sometimes complete fibrosis and even calcification of the appendage makes the normal route of entry impossible. Entry is then most easily achieved by the use of a purse string suture and the Rumel tourniquet. There is almost always an area just at the entrance of the superior vein through which the finger can be passed into the atrial cavity.

Organized clot was found in the atrial cavity on 50 occasions. In 6 of these no entry could be made into the atrial cavity. On one occasion a calcified appendage was completely excised with success. In these 50 cases, there were 3 deaths at operation.

(a) The first death was caused when an adhesion between organized thrombus and atrial wall in the region of the superior pulmonary vein was torn. This was done as the surgeon attempted to pass his finger between the organized clot and the atrial wall in an endeavour to enter the atrial cavity proper. Haemorrhage was severe and the position soon became irretrievable.

(b) In the second case death was caused when the surgeon entered a massively clotted auricle resulting in multiple massive emboli.

(c) In the third case the surgeon atempted to enter a calcified atrial cavity via the superior pulmonary vein. Stay sutures were placed around the distal ends of the vein. A transverse incision was made in the vein near its junction with the atrial wall and the finger inserted. The fragile atrial wall tore badly and, although haemorrhage was finally controlled, the patient did not survive the operation.

In the case of soft intra-atrial clot most surgeons have successfully used the method of atrial flushing described by Brock (1952).

There are certain features which most of the patients with fibrosed thrombosed atria had in common.

They were all in grade 3 or 4. They all had persistent auricular fibrillation and in many cases there were bursts of rapid fibrillation. X-ray examination of the chest, in most cases, revealed a flat left cardiac border, due to the shrinkage of the auricle brought about by thrombus formation.

(2) *Haemorrhage*

There was astonishingly little trouble from haemorrhage in the series. There were four deaths at operation; two of these have been described already. In the third case a scissors action of the auricular clamp took place leading to rapidly fatal haemorrhage. In the fourth case the ventricular wall was torn by the emergence of the index finger after very forcible dilatation of the lateral commissure.

There were 15 cases in which severe but ultimately controlled haemorrhage occurred. Three causes could be given for this:

(a) Too small an appendage.

(b) Too small an atrial isthmus.

(c) Too large a finger.

If the tear is on the pulmonary artery side it is usually necessary for the assistant to insert the necessary stitches. Control, in the meantime, can be almost always obtained by judicious placement of the exploring finger and the use of the other hand to keep the auricular invision snug about the exploring finger. Laterally placed tears towards the atrio-ventricular groove are most readily controlled by traction on the auricle towards the tear. The appendage itself, should the necessity arise, can be used to occlude the opening.

These tears can often be prevented by use of the following manoeuvres:

(a) A delibrate increase in the size of the cardiotomy wound towards the operator, where it is most easily controlled.

(b) The use of the little finger. Lillehei (1955) has picturesquely described this procedure as "sending a boy to do a man's job." However, the little finger will often fit into a small appendage, a fibrosed appendage, or a thrombosed appendage, when the index finger will not do so. Once the little finger has been inserted it is almost as effective as the index finger in fracturing the commissures.

(3) *Commissurotomy*

Many valves split with the greatest of ease, others with difficulty or not at all. A complete split was obtained of both commissures in 263 cases—41 per cent. A moderately good split (the whole of one commissure only or one and part of the other commissure) was obtained in 237 cases—36 per cent. A poor split or failure to split was obtained in 98 cases — 15 per cent. The presence of calcium in the commissures was a troublesome but infrequent cause of failure to split the commissures. The most common reason for failure was the presence of a rubbery resilient valve. All surgeons experienced difficulty with this type of valve, in particular with the medial commissure. All surgeons have found difficulty in the use of the mitral knife, in particular with its use in dividing the medial commissure. Most surgeons have developed a knife to suit their own particular requirements.

(4) *Calcium deposits*

Calcium was recorded as having been seen in the X-ray of the chest on 8 occasions and as gross at operation on 27 occasions, a total of 35. This suggests that its presence was often missed. It will be often missed unless it is looked for as a routine on screening. An analysis of the 35 cases is represented in Table 2.

TABLE 2

35 CASES GROSS CALCIFICATION

Unsuccessful Commissurotomy	*Successful Commissurotomy*	*Death*
23	12	4 { 3 Cerebral Calcific Emboli 1 I.C.C.F.

It will be noted that commissurotomy was unsuccessful in 23. It was successful in 12 cases. There were 4 deaths. We must infer that the presence of calcium, which is visible radiographically or which is gross when detected at operation, is a serious complication.

There is no doubt whatsoever that the presence of calcium is no bar to operation. Patients with calcium must be given a chance and the likelihood of a satisfactory commissurotomy, unless the calcium has embedded itself at the commissures, is good. In the 12 successful cases the results were excellent. If, however, a grade 2 or greater systolic murmur is coexistent it is the feeling of the writer that the valve is inoperable and is better left untouched. It means a valve which is hopelessly regurgitant and diseased. These valves usually cannot be increased in size by valvotomy, and should an increase in size be found possible, it only means greater regurgitation.

It is generally felt that the presence of gross calcification is an indication for clamping the great vessels prior to entrance into the auricular cavity.

(5) *Regurgitation*

Regurgitation was encountered as an unsuspected finding in 16 cases. In a further 13 cases in whom regurgitation was found in the presence of gross calcification no commissurotomy was carried out.

In 75 cases surgery was carried out in the presence of regurgitation (as evidenced by the presence of a grade 1 to 2 systolic murmur). Seventy cases were improved and 5 were unchanged following the valvotomy. In 2 of the last, regurgitation was gross and no commissurotomy was performed. Instead, inversion of the appendage was carried out by Hayward (1954), but the end results were unsatisfactory.

In 84 cases some degree of regurgitation was produced by valvotomy. In 71 of these stenosis was overcome, the regurgitation produced was slight, and the end result satisfactory. Nine others were unchanged, following valvotomy, 2 were made worse and there were 2 deaths. These findings can be summarized by saying:

(1) With careful examination and investigation regurgitation ought rarely be encountered as an unexpected finding.

(2) In minimum regurgitation the performance of valvotomy is indicated for this often results in significant improvement.

(3) Where regurgitation is produced at operation the results again are usually satisfactory, because it is a lesser evil than a tight stenosis.

(6) *Cardiac irregularities*

There were five deaths due to rhythm disturbances. Two of these were due to ventricular fibrillation.

(1) Ventricular fibrillation in a woman operated upon during pregnancy.

(2) Ventricular fibrillation in a patient in middle fifties. At autopsy evidence of gross coronary sclerosis was found.

The remaining three cases developed cardiac arrest during induction of anaesthesia; they could not be resuscitated. It is the writer's feeling that pentothal should in no circumstances be used in severely disabled mitral stenotics; it is a direct cardiac depressant. Since ceasing to use it we have had no trouble with fall in blood pressure prior to operation.

Bradycardia is a very definite sign of impending cardiac arrest. One should not wait for arrest before carrying out vigorous cardiac massage.

Emboli

Forty-nine cases had pre-operative emboli; 6 of these had post-operative emboli. There were in all 35 post-operative emboli of which 12 were fatal. The reasons for the fatal emboli are given in Table 3.

TABLE 3

CAUSE OF FATAL EMBOLI

Gross calcification of valve and calcific emboli	*Entering a massively clotted auricle*	*Surgery in a thrombosed auricle*	*No good reason*
3	2	5	2

It will be seen that emboli for the most part were associated with the presence of thrombosis in the auricle or calcification of the valve.

Pregnancy

Fourteen patients were operated upon during pregnancy; all were from three to five months pregnant; two of these died of ventricular fibrillation on the table. There were three post-operative miscarriages. In short 36 per cent. of these cases were failures.

It is the writer's feeling that most indications for surgery during pregnancy will occur during the third and fourth months; patients who pass into the fifth month will probably go to term successfully.

We had the misfortune to witness the death of a woman in the fourth month of pregnancy whilst in hospital awaiting valvotomy. She was a primipara aged 34 years. She had been reasonably well until she became pregnant. Late in the second month she became extremely breathless, had attacks of paroxysmal cardiac dyspnoea and one or two small haemoptyses. She was admitted towards the end of the third month for consideration of valvotomy; it was decided that this ought to be carried out. She was prepared for valvotomy but on the night before operation developed a tachycardia and operation was deferred. Two weeks later operation was again deferred, this time because of hyperemesis and ketonuria. A few days after this she had an attack of acute pulmonary oedema and died. Autopsy revealed a tight mitral orifice which split very easily. There is no doubt that valvotomy would have saved this patient.

On the other hand, the hyperdynamic circulation which occurs early in pregnancy can lead to an incorrect assessment of the case. If such people are put to bed and digitalized, they will for the most part improve remarkably and valvotomy will not be necessary. If they continue to have attacks of paroxysmal cardiac dyspnoea or pulmonary oedema then operation is certainly indicated.

Age

The youngest patient operated on was eleven years of age. This child had had a number of attacks of acute rheumatic fever; in addition, during the four months prior to admission to hospital, he had two attacks of acute pulmonary oedema, one of which was nearly fatal. Upon admission he was found to be considerably distressed. He sat quietly in bed and was afraid to move about too much; he had learnt the folly of undue exertion. Despite the recent rheumatic episodes, it was felt that valvotomy was warranted. A remarkable result was obtained. The child rapidly put on weight, returned to school, and now indulges in all the boyhood activities. He has had no further rheumatic activity. There are numbers such, not so incommoded perhaps, but undersized and restricted in their activities. There seems little reason why they should not have a chance of a normal life, even if there is some danger of recurrence of rheumatic attacks and restenosis. In the years to come there is no doubt that these valves will be able to be operated upon a second time.

Two operations

Only two patients have had a second operation. In one of these nothing was done; in the second a very successful result was obtained. The patient, a girl of 21 had the first operation in August, 1951. She was operated upon on that occasion because of numerous recurrent attacks of acute pulmonary oedema; she was extremely disabled at that time. A valvular dilatation rather than commissural fracture was performed. Following this operation she developed cardiac failure and a second thoracotomy was necessary to turn out a large coagulated hydropneumothorax; following this she made a good recovery. Despite the minimum increase in size obtained, in the succeeding four years the patient had little disability and only one small haemoptysis. However, early in 1955 symptoms recurred, she became dyspnoeic and the signs of tight mitral stenosis were present. The second operation was carried out in June, 1955; this time a very satisfactory commissurotomy was performed and the patient has since been in excellent health.

Very little coincident surgery has been carried out on other valves; in all upon only 6 cases. The aortic valve has been operated upon three times; in two cases the results were good and in one the patient died. The tricuspid valve has been operated upon on three occasions. In two of these tricuspid stenosis was found, and the results have been good. In one other tricuspid regurgitation was found.

RESULTS

(1) *Deaths*

There were 43 deaths (7 per cent.) of which 38 took place in the post-operative stage. It is quite possible that there have been more than five late deaths, as we have been unable to trace all cases. The causes of the operative deaths are given in Table 4.

TABLE 4

CAUSE OF OPERATIVE DEATHS

Haemorrhage—		
At Operation	4	
Post-operative	1	
	—	5
Emboli		14
V. Fibrillation		3
A. Stenosis		1
C.C.F. & P. Oedema		4
Pre-operative Cardiac Arrest		3
Regurgitation		2
Unrecorded		6

(2) *General results*

Good results (a rise of two grades in the state of the patient) were obtained in 330 cases—51 per cent. A rise of one grade was obtained in 154 cases—24 per cent. Bad results (no improvement or the patient worse) were obtained in 114 cases—18 per cent. The main reasons for the poor results were advanced lung changes, incomplete commissurotomy and pre- and post-operative regurgitation.

CONCLUSION

The overall mortality was 7 per cent. The results in general have been quite satisfactory. We would stress that great care ought to be given to the selection of patients for valvotomy during pregnancy. We feel that age is no bar and that there are probably many young people who should not be denied valvotomy.

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FALLOT'S TETRAD AND PULMONARY ATRESIA

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THE principle of increasing the flow of blood through the lungs in patients with Fallot's Tetrad was introduced by Blalock in 1944. At first he advised anastomosing the innominate or a subclavian artery to a pulmonary artery but it was soon found that division of the innominate artery was followed by a high incidence of cerebral damage and use of this vessel was abandoned. In 1946, Potts, Smith and Gibson described an ingenious clamp for use in making an opening between the aorta and a pulmonary artery and, in 1948, Brock described the operations of pulmonary valvotomy and infundibulectomy, which have become known by his name.

For the purpose of this discussion, all members of the Thoracic Section of the Royal Australasian College of Surgeons were asked to review their cases and in Table 1 the figures received are tabulated.

TABLE 1

	Totals	*Deaths*	*Individual Series*					
			A	*B*	*C*	*D*	*E*	*F*
Patients	240		157	59	11	5	4	4
Operations	253		168*	60	11	5	4	5
Shunts	204	24	142–12	42–7	10–3	5–2	1–0	4–0
Blalock (140)		15	91–7	42–7		2–1	1–0	4–0
Willis-Potts (54)		6	51–5			3–1		
Not Specified (10)		3			10–3			
Brock	30	10	8–4	17–5	1–1		3–0	1–0

*18 of these operations were thoracotomies only.

The mortality for patients who had shunt operations has been 12 per cent. and, of those treated by Brock's direct operation, 33 per cent. have died. If the largest individual series of each group is alone considered, the mortality for shunts has been 8 per cent. and for direct operations 29 per cent. It must be appreciated that neither type of operation makes the heart normal and the result of operation is influenced by a number of factors, of which the most important are the state of the outflow tract of the right ventricle, the degree of over-riding of the aorta and the development of the pulmonary vessels. Occasionally the arrangement of the systemic arteries may complicate the performance of a shunt operation. These factors all vary from case to case and the only constant result achieved by a technically satisfactory operation is an increase in the volume of the pulmonary blood flow. It seems plausible to suggest that this is better done by enlarging the natural outflow tract from the right ventricle but, if this is done really adequately, the right to left shunt may be reversed and the evils of the remaining ventricular septal defect may be no less than those of Fallot's Tetrad. Probably the success of the direct operation depends on the fact that really adequate restoration of the outflow tract by blind surgery is rarely possible. Campbell and Brock reviewing their first 100 direct

operations found that the results were no better than those of shunt operations and, even in Brock's hands, the mortality was a little higher for the direct operation.

Because of the many variables in these patients, it is difficult to make a scientific assessment of post-operative improvement. Cyanosis, clubbing of fingers, polycythemia, heart size on X-ray and capacity for exercise must all be considered. The important factor is the patient's capacity for exercise and, if this is adequately increased, the result is good. If cyanosis, clubbing and polycythemia are all reduced and the heart not greatly increased in size, so much the better, but some of our patients with the best exercise tolerance still have considerable polycythemia and some have unduly enlarged hearts. These operations are palliative; but it is better to have adequate exercise tolerance and a large heart than a small heart in a patient who cannot get about.

Detailed analysis of the collected figures has not been possible and I propose, therefore, to illustrate some points with reference to our own series of 157 patients shown in Table 2.

TABLE 2

ALFRED HOSPITAL SURGICAL, THORACIC AND CARDIOVASCULAR UNIT

Total Patients	157
Fallot's Tetrad	134 with 16 deaths
Pulmonary Atresia	11 with 2 deaths
Tricuspid Atresia	3 with 1 death
Transposition of Great Vessels	3 with 1 death
Eisenmengers	2 with no deaths
P.S. with A.S.D.	2 with 1 death
P.S. with V.S.D. without Over-riding	1 with no death
Cor Biloculare	1 with 1 death

(P.S.—Pulmonary stenosis. A.S.D.—Atrial septal defect. V.S.D.—Ventricular septal defect.)

Three patients with tricuspid atresia had Blalock's operations done and 2 have done well. The patients with transposition of the great vessels and Eisenmenger's syndrome and pulmonary stenosis with atrial septal defect were operated on early in the series before adequate methods of diagnosis had been developed. One other interesting patient with complete transposition of viscera was known to have a pulmonary stenosis with an atrial septal defect and at operation a ventricular septal defect was found as well, but there was no over-riding and this patient did well after valvotomy.

A total of 134 of these patients were suffering from Fallot's Tetrad and the operations performed on them are shown in Tables 3, 4 and 5.

TABLE 3

FALLOT'S TETRAD

134 PATIENTS WITH 16 DEATHS

Blalock's Operation	82 with 4 deaths
Willis-Potts Operation	46 with 4 deaths
Thoracotomy	9 with 4 deaths
Valvotomy	5 with 2 deaths
Infundibulectomy	2 with 2 deaths
Total Operations	144 with 16 deaths

TABLE 4

FALLOT'S TETRAD

THORACOTOMY ONLY

Pulmonary Artery too small for Shunt (1 bilateral)	4 patients (5 ops.) with 3 deaths
No Pulmonary Artery on left side	1 patient with 1 death
Closure of L.P.A. caused Cardiac Arrest? R.P.A.	1 patient with no death
"Coarctation" of Left Subclavian Artery	2 patients with no deaths

TABLE 5

FALLOT'S TETRAD

2 OPERATIONS COMPLETED

Right Blalock added as Symptoms Recurred after Left Blalock	5 patients with 1 death
Valvotomy with no improvement; Left Blalock successful	2 patients with no deaths

Six patients were found at thoracotomy to be inoperable. In 4 of these the pulmonary arteries were too small for anastomosis (one of these was explored on both sides), and in one there was no left pulmonary artery. In the other patient closure of the left pulmonary artery was followed by cardiac arrest and it was assumed that there was no right pulmonary artery.

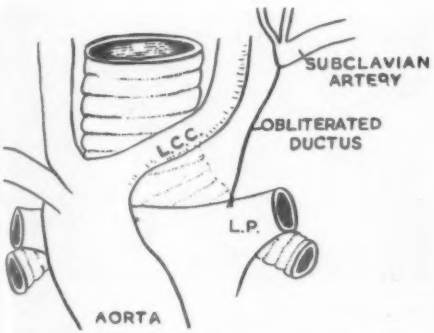


FIG. I. Left subclavian artery not directly connected to aorta but attached to pulmonary artery by a long obliterated ductus.

In 2 patients no improvement followed valvotomy and a shunt was added later with improvement in each of them. Five patients, who had shown satisfactory early improvement following Blalock's operations on the left side, did not maintain their improvement as they grew and a second Blalock operation was done on the right side in each of these children. Two patients with right-sided aortas had left subclavian arteries high in the chest and not connected to the aorta but connected by a long obliterated ductus to the pulmonary artery so that anastomosis could not be made on this side (Fig. I). It was only after the second of these children had been explored that we noticed that neither of them had a radial pulse on the left side and since then we have always carefully palpated both radial arteries and taken the blood pressure on both arms before doing a shunt operation.

Eleven patients suffered from complete pulmonary atresia.

TABLE 6

PULMONARY ATRESIA

11 PATIENTS WITH 2 DEATHS

Minute Pulmonary Arteries; Shunt impossible	5 patients with 1 death
Blalock (good, fair, untraced)	3 patients with no deaths
Willis-Potts (very good, poor, death)	3 patients with 1 death

Five had minute pulmonary arteries quite unsuitable for anastomosis but in 6 a shunt was made with one very good result and one good one. The aorta was right-sided in 28 or 19 per cent. of 145 patients with Fallot's Tetrad or pulmonary atresia.

Follow-up

The patients in our series were all operated on between 7th October, 1947, and 31st December, 1954, and the period of follow-up varies from 7½ years to 6 months.

A total of 157 patients were operated upon but 22 died and in 8 of the survivors only a thoracotomy had been done, so that 127 patients survived a completed operation. Thirty of these are at present untraced and 97 have been completely followed up and our assessment of their present state is tabulated in Table 7.

TABLE 7

PRESENT STATE OF 97 PATIENTS

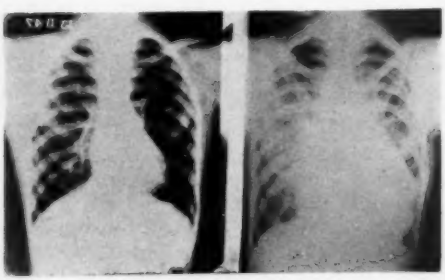
Very good	—	62
Willis-Potts	29	
Blalock's	33	
Good	—	19
Willis-Potts	5	
Blalock's	13	
Valvotomy	1	
Fair	—	8
Poor	—	4
Died since operation	—	4

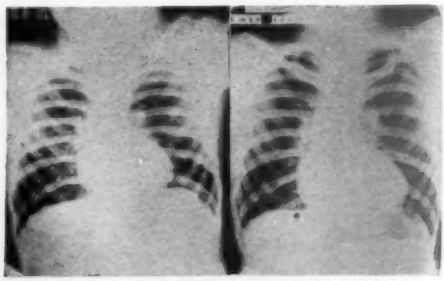
We have classified 62 patients as having very good results and 29 of these had Willis-Potts operations and 33 had Blalock operations; of the 19 patients we look on as good results, 5 had Willis-Potts operations and 13 had Blalock operations. Eight patients are classified as fair and 4 as poor results and 4 patients have died since operation.

showed that the hearts in most of our patients before operation were normal in size or only slightly enlarged and after operation there was usually a slight increase, but 2 patients now have very grossly enlarged hearts; both of these had Willis-Potts operations and one is classed as good and the other as fair. Three patients have considerably enlarged hearts. One of these had a Willis-Potts operation and the other 2 had Blalock operations. One is classed as very good, one is good and the other is fair. In 15 patients there was more than usual enlargement and 9 of these had had Willis-Potts operations and 6 had had Blalock operations. Ten are classed as very good, 2 are good, one is fair and 2 not traced.

Comparison of Willis-Potts and Blalock operations

When we began this work we felt that the left pulmonary artery was a much more satisfactory vessel to work with than the right one and that Willis-Potts' operation was easier than Blalock's and so we decided to do all





P.A. films of heart before and after operation.

FIG. II. Shows extreme enlargement of heart after operation.

FIG. III. Shows average post-operative enlargement.

Before operation these patients showed haemoglobin levels varying from low normals up to as much as 28 gms. per cent. The average before operation was 20.3 gms. per cent. and now the average level for the same patients is 17.5 gms. per cent. and these figures are very similar to those sent in from the Cardio-Surgical Unit at Green Lane Hospital, Auckland, New Zealand, where the average pre-operative value was 19.38 gms. per cent. and this was reduced by operation to 16.51 gms. per cent. X-ray examination

operations on the left side, making a pulmonary-aortic anastomosis as a routine but doing a subclavian-pulmonary anastomosis when the aorta was right-sided. With increasing experience we tended to do more and more Blalock operations. For the complete series the mortality of the Willis-Potts operation is a little higher than for the Blalock operation but this is explained by 2 early deaths due to technical errors. The 2 largest hearts resulted in patients who had early Willis-Potts operations, when we were mak-

ing the incision in the aorta $\frac{3}{8}$ inch long. Now it is made exactly $\frac{1}{4}$ inch long. Of the 62 patients with very good results, 29 had Willis-Potts operations and this represents 71 per cent. of the survivors who have been followed up and compares favourably with 34 very good results or 53 per cent. of those who survived a Blalock operation. If the patients with good results are included, too, the Willis-Potts operation has given 87 per cent. of good and very good results and the Blalock operation 74 per cent. of similarly good results.

In the total series of patients sent in (Table 1) 30 direct operations by Brock's methods have been done and 10 of these patients died. Twenty-one valvotomies resulted in 6 deaths. Ten of the survivors are classified as very good, 2 are good, 3 were not improved and 2 of these have had Blalock shunts added and have done well with this operation. Infundibulectomy was done in 9 patients with 3 very good results. Two other patients are classified as fair and 4 died.

In conclusion, it is apparent that, in the patients reviewed, shunt operations have shown a lower mortality and better end results than direct operations and in our own series from the Alfred Hospital, Willis-Potts' operations have given better results than Blalock's operations. In some cases, no operation was possible and in others with pulmonary atresia a systemic pulmonary shunt was possible but direct operations could not have been done. Possibly in our 2 patients with only one pulmonary artery, a direct operation might have been possible but a shunt could not be done.

I had always felt that radical cure of Fallot's Tetrad was unlikely to be achieved, but in Philadelphia last April Lillihei reported his experience with 9 patients with Fallot's Tetrad operated upon with the aid of cross circulation. In all of them he resected the infundibulum and repaired the ventricular septal defect and, although 4 died, he had 5 good results and he believes that, as his experience grows, he will be able to cure the majority of these patients. In view of this, I feel that at present one should defer operation in patients who are not severely handicapped. If operation is to be done, an extracardiac shunt should be preferred to a direct operation that interferes with the right ventricle and, because it would be easier to undo, I should prefer Blalock's operation to that of Willis-Potts.

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PRECANCEROUS MELANOSIS OF THE CONJUNCTIVA

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PRECANCEROUS melanosis may be defined as an intraepithelial proliferation originating in the basal cells of the epidermis or of epithelia. In 1891 Jonathan Hutchinson drew attention to the development of epithelial cancer in senile freckles and in areas of dermal melanotic staining in adults and his description of these cases constitutes one of the earliest records of precancerous melanosis. The first writer to use the term precancerous melanosis, however, appears to have been Dubreuilh who, in 1912, introduced the designation as an improvement on *Lentigo maligna* which he had employed for the same lesion in previous publications (1894).

During the last 60 years, a small but constant stream of reports has appeared, especially in the French literature, of conjunctival lesions which may now be reasonably identified as malignant melanomata originating in areas of precancerous melanosis. The authors of these reports have employed a wide variety of terms including melanotic sarcoma, melanotic carcinoma, naevocarcinoma, *tache mélanique* and *lentigo maligna*. Descriptions of the conjunctival lesion in its precancerous phase are rare but the case described by Walker in the Proceedings of the Royal Society of Medicine in 1928, under the title of "Melanosis of the Lid and Conjunctiva," appears to have been a genuine case although no histological examination was made. More recently Hicks, Rank and Wakefield (1955), in a study of pigmented skin lesions, describe dermal precancerous melanosis as a diffuse junctional naevus and state very truthfully that this is a clear-cut clinical entity which deserves more attention than it has received in the past.

In 1943, Reese somewhat clarified the position in a paper on precancerous and cancerous melanosis of the conjunctiva and skin. He defined cancerous melanosis as a malignant melanoma originating from a pre-existing precancerous lesion and, in a review of the literature, identified 42 definite or probable cases of this condition. On the evidence of the cases in the literature and of his own experience, he believes that cancerous melanosis is by far the commonest type of malignant melanotic growth of the conjunctiva, and that malignant change in a congenital pigmented naevus is rare.

My experience of pigmented lesions of the junctiva at the Institute of Ophthalmology in London leads me to disagree with this conclusion. Thus of 153 pigmented lesions of the conjunctiva, limbus, caruncle and *plica semilunaris* examined histologically in the period 1948 to 1954—

77 per cent. were pigmented naevi;

20 per cent. were malignant melanomata;

3 per cent. were precancerous melanosis.

Of the 30 malignant melanomata, 3 showed surviving islands of small, typical, quiescent naevus cells, suggesting a naevus origin, and 9 were malignant melanomata, developing in areas of precancerous melanosis of which there was histological evidence in the epithelium at the perimeter of the malignant focus. In the remaining 18 cases there was no histological indication of the mode of origin of the malignant growth, which may therefore have developed from a naevus, from a precancerous melanosis or, *de novo*, without a pre-existing lesion.

In addition, among the 118 naevi, there were 10 in which increasing size, deepening pigmentation, and cellular anaplasia, suggested early malignant change.

These figures show that precancerous melanosis of the conjunctiva is a rare condition, and that in the majority of cases, excision is not done until the cancerous phase has supervened. In addition, they support the view that malignant change in a conjunctival naevus probably occurs more often than Reese has suggested.

CLINICAL FEATURES

The lesion commences as a flat, pigmented macule and spreads gradually, remaining flat and extending laterally, until eventually the whole of the bulbar and palpebral conjunctiva, caruncle and adjacent skin of the lids may be involved in a flat, finely granular pigmentation. I have observed that, in its early stages, the lesion may reproduce with extraordinary exactitude the appearance of candle wax spread thinly upon the conjunctival surface. Occasionally the precancerous change synchronously develops over the greater part of the conjunctiva, a fact that can be appreciated clinically only by the minutest scrutiny. While the common tendency is for the lesion to spread and enlarge progressively, spontaneous regression has been noted. In one of Reese's (1943) cases the lesion became clinically extinct without treatment but later reappeared.

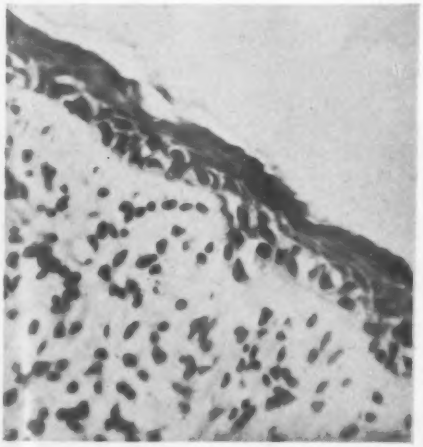

FIG. I. Early junctional proliferation showing basal cell multiplication and vacuolation. Haematoxylin and eosin. (x 340)

The precancerous phase commonly lasts for 5-10 years but may be shorter or much longer. According to Reese, malignancy almost invariably supervenes if the patient lives long enough. One or more malignant foci develop, either simultaneously or successively and although these may become elevated to form obvious tumours they more often remain almost flat and may, indeed, metastasize and kill the patient without ever becoming appreciably raised above the surrounding epithelial surface. The common signs of malignant change are enlargement, deepening pigmentation and inflammation in the precancerous area but these may well escape detection unless the patient is under close surveillance.

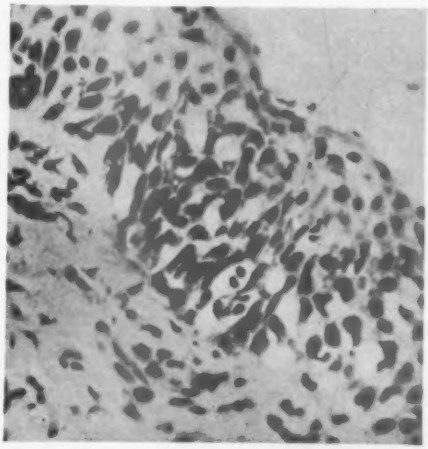

FIG. II. A more advanced stage showing the addition of several layers of proliferating cells to the deep surface of the epithelium. Haematoxylin and eosin. (x 340)

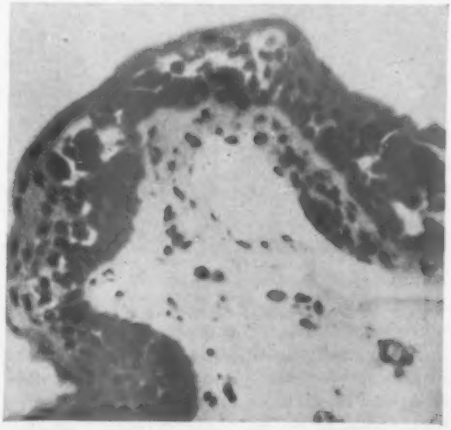

FIG. III. Intraepithelial segregation to form pigmented nests. Haematoxylin and eosin. (x 340)

HISTOGENESIS

The earliest changes, which closely simulate junctional change in a pigmented naevus, occur in the basal cells of the epithelium over a wide area (Fig. I).

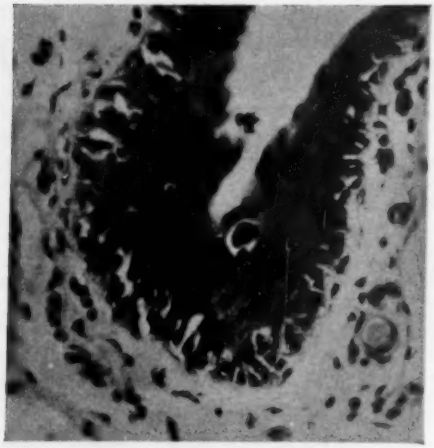

FIG. IV. Isolated pigmented cells working toward the surface. Haematoxylin and eosin. (x 340)

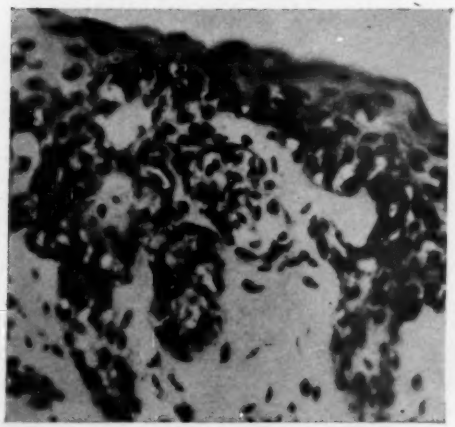

FIG. V. Basal cells proliferating downward in buds and branching strands. Haematoxylin and eosin. (x 340)

These cells multiply in number, increase in size and become pigmented and separated from one another by clear spaces. The cells now show large pale nuclei and abundant cytoplasm which may be clear, contain fine pigment granules, vacuoles or droplets, or exhibit a fine cytoplasmic network similar to that seen in foam cells. Contiguous cells fuse to produce spaces containing degenerate nuclear fragments (Fig II).

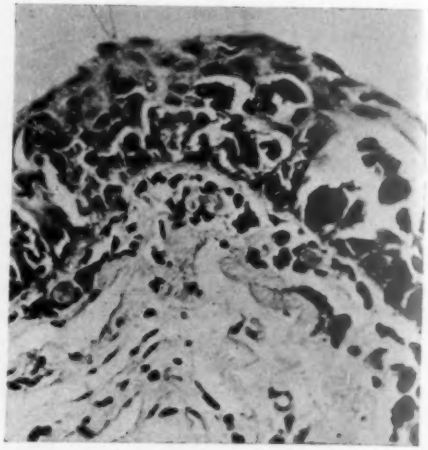

FIG. VI. Advanced precancerous melanosis. Numerous pigment laden macrophages are present in the superficial submucosa. Haematoxylin and eosin. (x 340)

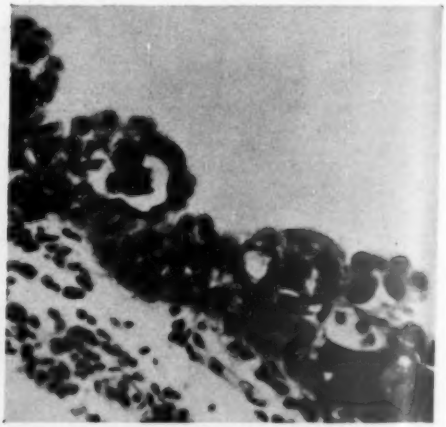

FIG. VII. Border-line lesion. Neoplastic cells have largely replaced the epithelium without, however, invading the submucosa. Haematoxylin and eosin. (x 340)

The cells proliferate intraepithelially adding several layers to the deep surface of the epithelium and segregate to form intraepithelial nests which contrast sharply with the normal mucosa in which they lie. It is these

pigmented nests which impart the characteristic granularity to the surface of the lesion and the fact that the proliferation is entirely intraepithelial which accounts for the flat nature of the lesion (Fig. III).

Isolated clear or pigmented cells may also be seen being worked through the epithelium towards the surface (Fig. IV).

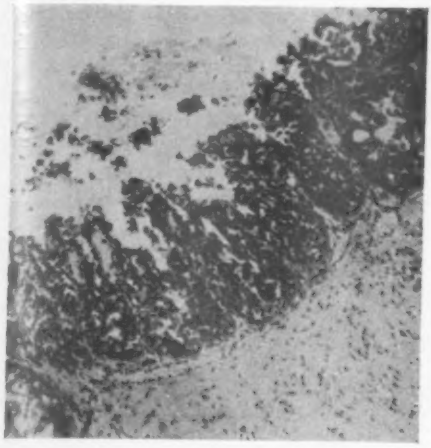

FIG. VIII. Superficial malignant melanoma. Neoplastic tissue replaces both epithelium and submucosa and lines the internal surface of the tarsal plate (below). Haematoxylin and eosin. (x 80)

As the lesion develops the proliferating cells push downwards either in solid buds or strands and the submucosa is invaded by chronic inflammatory cells among which macrophages loaded with coarse pigment granules may be seen (Fig. VI).

Further development consists in the virtual replacement of the whole thickness of the epithelium by pigmented vacuolated cells (Figs. VI and VII).

Histologically, the onset of malignancy is indicated by the invasion of the submucosa by large, globular, clear or finely pigmented malignant cells from the overlying mucosa where they are present in large numbers throughout all its layers. Nuclear anaplasia and vacuolation and mitotic figures are additional indications, mitotic figures being particularly significant as they are rarely, if ever, seen in the precancerous phase. Submucosal small round cell infiltration is usually evident (Fig. VIII).

Malignant melanoma supervening upon precancerous melanosis has been termed by Reese (1943) cancerous melanosis. This seems an unnecessary elaboration of an already confused nomenclature, for cancerous melanosis is clinically and histologically a superficial malignant melanoma and is identical with the superficial melanocarcinoma of Allen and Spitz (1953).

DISCUSSION

Reese (1943) defined precancerous melanosis as an acquired neoplastic change occurring in the conjunctiva of middle-aged and elderly persons and noted that it also occurred in the skin. He distinguished sharply between precancerous melanosis and the pigmented junctional naevus on the grounds that the naevus is a congenital, circumscribed and elevated lesion which rarely becomes malignant and is radio resistant; while precancerous melanosis, on the other hand, is acquired in adult life, is flat and diffuse, inevitably becomes malignant and is radiosensitive in its early stages.

These contentions appear to be based on a very small series of cases, 17 in all, of which 5 were in the precancerous and 12 in the cancerous phase. My experience of pigmented lesions of the conjunctiva leads me to suspect that malignant melanomata of the conjunctiva not infrequently originate in preexisting naevi. In addition, the view that precancerous melanosis eventually becomes malignant in every case, although possibly correct, does not seem to have been satisfactorily proved. Additional clinico-pathological observations seem desirable to illuminate this point in particular.

Becker (1954), who is one of the few writers who makes any direct reference to conjunctival precancerous melanosis, believes it to be a form of *lentigo maligna*, occurring in a mucous surface, but otherwise strictly comparable in morphology and evolution with epidermal lentigo, which he regards as *melanoma in situ* or a premelanomatous condition.

Allen and Spitz (1953) describe an uncommon superficial malignant melanoma (melanocarcinoma) principally in the female external genitalia which remains flat while spreading centrifugally over wide areas. This is histologically identical with Reese's cancerous melanosis and it seems not unreasonable to suppose that it is sometimes preceded by a precancerous phase. Indeed, it is possible that melanotic precancerous lesions occur in other sites such as the oral and nasal cavities, upper respiratory tract and at the ano-rectal junction, but often remain unrecognized because they are not readily seen and because they produce few symptoms until malignancy supervenes. Allen and Spitz (1954) also stress the poor prognosis of malignant melanoma in mucous membranes and suggest that the paucity of early symptoms, the misintrepretation of the histological picture of border-line lesions and the difficulties of adequate surgical excision, are among the contributory causes.

For reasons previously mentioned, the introduction of the term cancerous melanosis seems unnecessary, and the question must inevitably arise whether conjunctival precancerous melanosis can be profitably distinguished from the pigmented naevus. I believe that it can and that the two lesions exhibit sufficient differences to merit separate consideration. The reasons for this view may be briefly summarized as follows:

CONJUNCTIVAL PRECANCEROUS MELANOSIS	CONJUNCTIVAL JUNCTIONAL NAEVUS
1. Acquired in adult life (40 to 50 years of age).	1. Congenital or tending to appear in adolescence or early adult life.
2. Eventual malignancy though to be inevitable.	2. Only minority becomes malignant.
3. Flat diffuse and progressive habit of growth. More than one pigmented area may be present. Tumour formation indicates malignant change.	3. Characteristically sharply circumscribed, almost always elevated (slit lamp) and commonly single. Increase in size may indicate malignant change.
4. Within pigmented area, junctional change shows spatial continuity over wide area.	4. Junctional proliferation tends to be in discrete foci with normal epithelium intervening.
5. Proliferation is intraepithelial. Any penetration by proliferating cells into submucosa constitutes malignant invasion.	5. Dropping down of benign naevus cells into submucosa is characteristic of the natural evolution of the growth.
6. Said to be radio-sensitive in early stages.	6. Majority are radio-resistant.
7. Essentially an intraepithelial carcinoma analogous to Bowen's disease.	7. Hamartoma.

In conclusion, it may be said that precancerous melanosis is an intraepithelial proliferation originating in the basal cells of the conjunctival epithelium, or of the skin. It is analogous to Bowen's intraepithelial carcinoma or to extra-mammary Paget's disease where that condition can be divorced from any primary malignancy in the underlying apocrine glands. Its kinship with extra-mammary Paget's disease receives support from Stout's (1938) observations upon a rare intraepidermal melanoma in the skin characterized by long duration, superficial spread and a histological picture closely simulating Paget's disease.

It would seem that further clinical and pathological observations are necessary before the nature, habits and relationships of precancerous melanosis can be regarded as finally settled.

ACKNOWLEDGEMENTS

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CARCINOMA OF THE GALL-BLADDER

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CARCINOMA of the gall-bladder is a rare clinical diagnosis and is usually made long after the disease is operable. Experience with several cases, in which the diagnosis was not suspected clinically, prompted this study. Consideration of clinical features suggests the possibility of earlier diagnosis in some cases. The records of 27 cases subjected to autopsy or laparotomy have been examined.

Incidence

Statistics of the occurrence of the disease are difficult to assess. Cases of unexplained jaundice and cachexia or widespread carcinomatosis, in which autopsy or laparotomy are not performed, are usually certified as being due to a primary growth in the stomach or large bowel. The disease may be commoner than is apparent. Glenn and Hays (1953) found an incidence of 0.43 per cent. among 206,908 autopsies surveyed. Arminski (1949) quotes an occurrence of 4.53 per cent. of all carcinomas.

The disease is rare in animals but is recorded in the hen and the cow by veterinarians. It is of interest that only those animals having the ability to convert a discontinuous to a continuous food digestion, possess a gall-bladder.

Age and Sex

Arminski (1949) reviewing the literature found that 93.6 per cent. of cases occurred in patients between 40 and 80 years; he also found that 73.1 per cent. occurred in females. These findings are in accord with those of other authors; Rolleston and McNee (1929) found 71 per cent. in females. In the present series 62.3 per cent. occurred in females, and in only one case was the patient under the age of 40.

Aetiology

The concurrence of cholecystitis and lithiasis with the disease is a striking feature in the majority of reports in the literature. We were able to confirm the association with stones in only less than half of our cases, but this could not be definitely excluded in some of the records. Roberts (1954) found stones in 75 per cent., Willis (1952) in 92.3 per cent. and Arminski (1949) in 73.2 per cent.

The essential factor in causation is not known, but these factors are incriminated:

(a) chronic irritation by the stones;

(b) some chemical carcinogen in the stones;

(c) precancerous inflammatory hyperplasia associated with long continued infection.

Ewing (1928) considered that all these factors operate, with the addition of irritation by bile and disturbances of cholesterol me-

TABLE 1

AGE AND SEX INCIDENCE

Nearly two-thirds occurred in females. This predominance is constant, for example, 71 per cent. in Rolleston and McNee's 3,242 cases (1929).

	0-30	30-40	40-50	50-60	60-70	70-80	80-90	
Female	0	1	2	2	6	5	1	17
Male	0	0	0	1	6	1	2	10
Total	0	1	2	3	12	6	3	27

There were 3 female diabetics (one-seventh of the total). The incidence of the disease in diabetic patients has not been noted in any previous communications on the disease. Only one of these 3 was found to have gall-stones.

bolism. Arminski (1949) stresses the constant finding of chronic inflammation in gall-bladders showing early carcinomas. Willis (1952) points out that carcinoma may develop many years after removal of stones. Roberts (1954) enters a plea for early cholecystectomy in cases of symptomatic gall-stones, in the hope of improving the results of treatment. It is of interest to note here that Arminski (1949) records the finding of carcinoma in 1.12 per cent. of 46,480 operations on the biliary tract. It is probable that many of these gall-bladders were not subjected to pathological examination.

FIG. I. Photograph showing carcinoma of the gall-bladder involving fundus. It is associated with stones.

PATHOLOGICAL FEATURES

The disease at present is infrequently studied in its early stages. In only one of our cases was the growth confined to the gall-bladder at the time of diagnosis.

FIG. II. Diffuse carcinoma of the gall-bladder invading liver; it is associated with stones.

Gross appearances

The disease appears to arise more commonly in the fundus than elsewhere, although in many cases, at the time of examination, the entire organ is involved. Vadheim *et alii* (1944) found 53 per cent. of their cases involved the fundus. Two main types of growth are described:

(a) a polypoid and papillary mass projecting into the lumen. Willis (1952)

subdivides this group into predominantly mucoid and non-mucoid types;

(b) a scirrhous, diffusely infiltrating type. This commonly involves a large proportion of the mucosa.

1. Perforation with:
   (a) the formation of fistulae into the duodenum, stomach or colon;
   (b) diffuse peritonitis;
   (c) local abscesses in the liver or round the gall-bladder.

TABLE 2

PATHOLOGICAL FEATURES

The tumour was localized to the gall-bladder in only one case. There was direct infiltration of the liver in practically half and involvement of adjacent organs in a quarter of the cases.

Localized to the gall-bladder		1
Local direct infiltration of the liver		13
Infiltration of adjacent viscera	Duodenum	3
	Common bile duct	3
	Pancreas	1
	Total	7
Fistula into adjacent viscera	Transverse colon	2
	Duodenum	1
	Total	3
Liver metastases		11
Local glandular metastases	Porta hepatis	8
	Coeliac	4
	Total	12
Remote metastases	Mediastinum	1
	Peritoneum	3
	Supraclavicular region	1
	Lungs	1
	On surface of the spleen	1
	Total	7

Enlargement of the organ is inconstant and depends solely on the complications of obstruction and infection.

The local complications are of importance because when they develop, the clinical features obscure the underlying condition. They are:

Microscopic appearances

The majority of the growths appear as some variety of adenocarcinoma. Arminski (1949) found that among 502 cases, 91.2 per cent. were adenocarcinomata. This group is subdivided into the following types:

(a) scirrhous and infiltrating; this type is the commonest, constituting 70 per cent. of the total;

(b) papillary;

(c) mucoid.

A quota of 4.9 per cent. of the growths showed a mixed cell picture, and 3.8 per cent. were predominantly squamous-celled. Willis (1952), discussing the latter group, is of the opinion that adenocarcinoma can always be found in some areas of the growths.

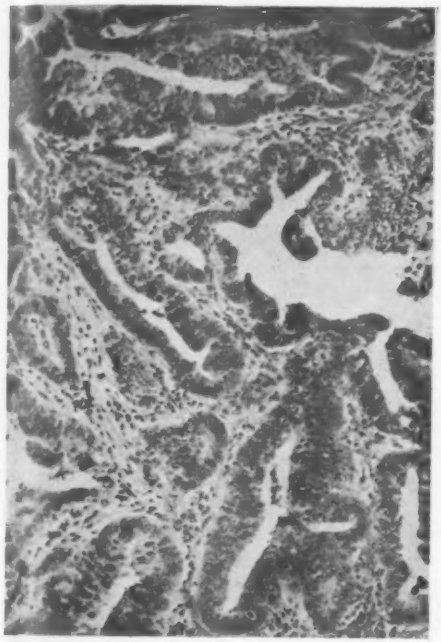

FIG. III. Photomicrograph of a papillary adenocarcinoma. (x 160)

Spread

Most of the clinical features seem to be manifestations of spread of the disease. Vadheim (1944) found extension and metastasis in 64 per cent. of cases.

1. Local spread:

(a) the disease spreads by submucosal and subserosal lymphatics to the cystic node and thence to nodes in the porta hepatis and coeliac groups. Spread by lymphatics also leads to widespread peritoneal deposits;

(b) direct spread into the liver across the gall-bladder bed is a common occurrence;

(c) spread to the pleurae and lung bases may occur via lymphatics in the diaphragm;

(d) direct spread into adjacent viscera gives rise to the formation of fistulae, into the stomach, duodenum and transverse colon.

2. Distant:

Invasion of veins leading to widespread metastases occurs later than direct extension (Arminski, 1949). The liver contains discrete metastases in more than half the cases (Willis, 1952). Vadheim (1944) found similar discrete deposits in the liver in 73 per cent. of his cases.

Willis (1952) found that after the liver, the lungs, bones and ovaries were involved most commonly. According to the literature as reviewed by Arminski (1949), almost every organ has been the site of metastases.

The clinical syndrome

The presenting symptoms and signs depend on:

(a) the primary location and pathological variety of the growth;

(b) the degrees of local spread producing pressure effects on, or infiltration of, the neighbouring structures;

(c) the rate of spread to the porta hepatis glands or liver tissues producing an obstructive jaundice.

The main symptoms

On an analysis of all cases reported by various authorities these were:

1.	Pain and vomiting	60 per cent.
2.	Jaundice	60 per cent.
3.	Anorexia	60 per cent.
4	Ascites and Oedema of lower extremities	40 per cent.
5.	Loss of weight—usually rapid (1 stone in 1 month)	50 per cent.
6.	"P.U.O."	20 per cent.
7.	An unexplained anaemia	20 per cent.
8.	An abdominal mass	15 per cent.

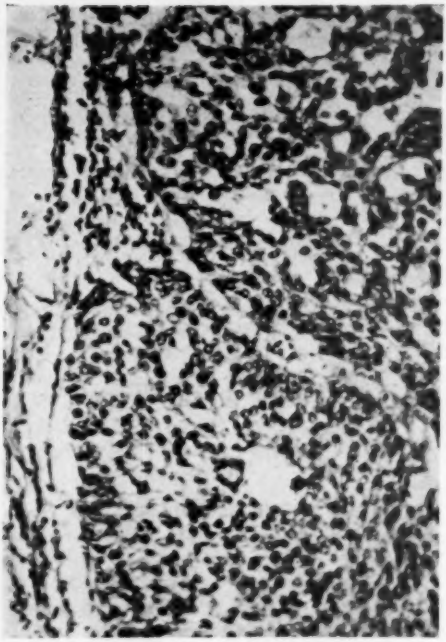

FIG. IV. Photomicrograph showing a diffuse spheroidal cell pattern. (x 240)

measures, a laparotomy and prophylactic cholecystectomy should be carried out in all cases with demonstrable gall-stones but in which the symptoms have altered to those of more persistent pain, jaundice, increasing anorexia and marked loss of weight (Graham).

The differential diagnosis

1. Carcinoma of the Liver—Primary and Secondary.
   Pain, jaundice and tumour.
2. Carcinoma of the Stomach.
   Tumour, or secondaries causing jaundice.
3. Carcinoma of the Hepatic Flexure of the Colon.
   Tumour or secondaries.
4. Carcinoma of the Head of the Pancreas.
   Tumour or jaundice.
5. Stones Impacted in the Common Bile Duct.
6. Cholangitis and Hepatitis.

The role of X-rays in diagnosis

Kirklin (1933) of the Mayo clinic made an extensive study of cholangiograms in an attempt to demonstrate the presence of carcinoma as a defect in the cholecystographic shadow. He felt that carcinoma of the gall-bladder should resemble gastric carcinoma in producing defects visualizable on cholangiography; he was forced to conclude that technically the procedure was unsatisfactory since the growth often interfered with the concentrating power of the viscus, or caused obstruction of the cystic duct. The gall-bladder, being small and shielded by the

TABLE 3

CLINICAL SYNDROME

Jaundice was the presenting symptom in more than half the cases, loss of weight in a quarter and a mass was palpated in a fifth of the cases.

Presenting Symptoms	*Female*	*Male*	*Total*
Loss of weight	5	2	7
Dyspepsia	3	1	4
Jaundice	9	7	16
Pain	2	0	2
A mass	4	1	5

Five per cent. of the cases were admitted to hospital as moribund cases of undiagnosed jaundice. Seventy per cent. had given a history of the flatulent dyspepsia clinically associated with "gall-bladder disease," the pain later becoming more constant in character with the appearance of anaemia, anorexia and progressive loss of weight.

Some clinicians are of the opinion that, as it is impossible to diagnose this all too fatal disease by any of the known ancillary

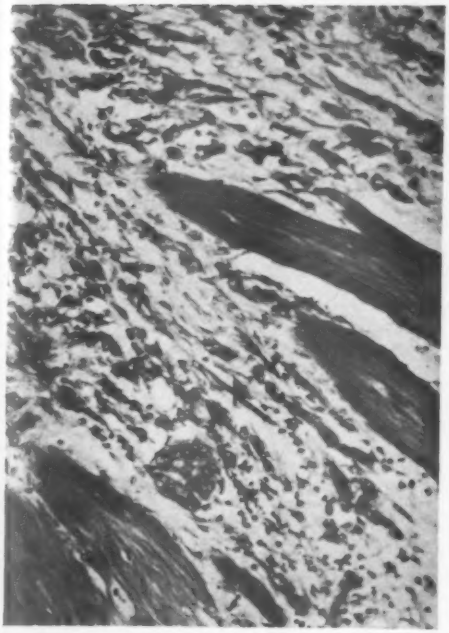

FIG. V. Photomicrograph showing a scirrhous spheroidal cell lesion infiltrating muscle. (x 190)

liver edge, is less amenable to manipulation on X-ray screening than is the stomach. The co-existence of gall-stones obscures defects that might otherwise be demonstrable. He was led to the conclusion that if on repeated X-rays the examiner observes a persistent defect with a diameter of 2 cms. or more and an irregular internal border he should take a papilloma or carcinoma of the organ into consideration.

In the only surviving case in the series to be presented (No. 24), the Graham's test revealed a filling defect; a papillomatous carcinoma in the fundus of the gall-bladder was found on the routine pathological examination of the organ.

Several of the patients had achlorhydria; in others the Gregerson's tests on the faeces were repeatedly positive (a finding mentioned by several writers). The small intestinal haemorrhages may be associated with the obstructive jaundice, or due to the direct infiltration of the intestine by the ulcerating neoplasm.

TABLE 4

OPERATIVE PROCEDURES

Removal of the tumour was practicable in two cases only, and a palliative procedure was carried out in three cases.

1. (a) Cholecystectomy		1
(b) Cholecystectomy and local liver resection		1
2. Relief of jaundice by cholecystostomy		1
3. Relief of mechanical obstruction to bowel:		
Duodenum	Gastro-enterostomy	1
Small bowel	Resection of a gangrenous loop caught up in the growth and dense adhesions	1
Transverse colon	By-pass ileo-colostomy	1
4. Inoperable		10
5. Biopsy		3
6. Drainage of local abscesses secondary to fistulae		2

TABLE 5

Patient		Sex	Age	Date of Admission	Diagnosis Procedure	Main Symptoms	Main Signs	Operation or P.M. Findings and Investigations	Presence of Stones	Date of Death
1	I.F.	F.	80	3 May, '44	P.M.	Admitted comatose	Abdominal mass Broncho-Pneumonia	P.M.—Columnar-cell carcinoma infiltrating liver	Nil	5 May 1944
2	H.W.	F.	67	17 Mar, '45	Operation P.M.	1 year Abdominal pains and vomiting		Laparotomy 20 Mar. 1945 Liver full of secondaries. P.M.–Liver and hilar nodes full of secondaries. G-B primary extending into liver by direct infiltration	Nil	25 Mar. 1945
3	I.J.	M.	64	5 Sept., '45	P.M.	3 months increasing jaundice 6 weeks abdominal pain	Enlarged Liver Jaundice Ascites	P.M.–Liver & gall-bladder one large mass. Columnar-cell infiltrating carcinoma.	Nil	7 Sept. 1945
4	D.P.	F.	39	31 Jan., '46	Operation P.M.	7 years flatulent dyspepsia 6 weeks abdominal pain and vomiting 1 month increasing jaundice	Enlarged Liver Jaundice	Laparotomy, 14 Feb. 1946. Gall-bladder and liver one large infiltrated mass. P.M.–Columnar-cell carcinoma of gall-bladder with direct involvement of liver	Nil	22 Feb. 1946
5	A.H.	M.	65	6 May, '46	Operation No P.M. granted.	9 weeks increasing jaundice Vomiting intermittently 3 stone loss of weight in 2 months	Jaundice Enlarged Liver	Operation, 23 May 1946. Carcinoma of gall-bladder infiltrating and encircling the common bile duct. No local secondaries	Nil	13 June 1946
6	M.M.	M.	74	22 July '46,	Operation P.M.	10 years Duodenal ulcer proven on X-ray 6 weeks increasing abdominal pain & vomiting.		Operation, 26 July 1946 ulcerating adenocarcinoma of gall-bladder neck with local cholecystitis. Healed scarred duodenal ulcer.	Nil	2 Sept. 1946
7	G.N.	M.	70	26 Dec., '46	P.M.	8 days burning abdominal pain & intractable diarrhoea. Loss of weight; 2 stone in 1 year	Enlarged Liver. Broncho-Pneumonia	P.M. Right Lung & Liver full of secondary deposits. 1 large stone in gall-bladder. Thick-walled with generalized growth infiltrating liver & secondary spread in lymph nodes of hepatic pedicle	1 Stone	13 Jan. 1947
8	A.N.	M.	70	12 June '47	Laparotomy P.M.	4 months Jaundice following Laparotomy Nov. 1946 for gall-stones when found to have liver secondaries	Jaundice Enlarged Liver	P.M. Carcinoma of gall-bladder; Extensive secondary deposits liver, mesenteric & coeliac lymph nodes	Several	16 June 1947
9	C.B.	M.	87	19 Sept. '47	P.M.	5 weeks indigestion and vomiting Jaundice 1 month	Enlarged Liver	P.M. Haemorrhagic papillary adenocarcinoma infiltrating the liver which contained many metastases. Enlarged hilar nodes. Duodenum infiltrated by growth	Nil	25 Sept. 1947
10	V.B.	F.	67	2 July '48	Operation No P.M. allowed	12 years Diabetic 1 month dyspepsia and jaundice	Jaundice Enlarged Liver	Operation, 19 July 1948. Carcinoma of neck infiltrating porta hepatis. Secondaries in omentum	Nil	27 July 1948
11	L.J.	F.	44	28 May '49	Operation No P.M. allowed	5 months flatulent dyspepsia 2 weeks jaundice 1 stone loss in weight in 2 months	Jaundice Enlarged Liver	Operation, 30 May 1949. Gall-bladder a hard mass infiltrating liver. Secondary tumours in liver and omentum	Several	12 June 1949
12	E.C.	F.	76	13 Sept. '49	Operation No P.M.	4 months right subcostal pain 1 month jaundice Glycosuria 1 week	Jaundice Enlarged Liver	Operation, 6 Oct. 1949. Gall-bladder mass infiltrating liver. Secondary tumours adherent to diaphragm and along porta hepatis	Nil	7 Oct. 1949
13	J.A.	F.	71	4 Aug. '50	Operation P.M.	5 years Diabetic 6 weeks vomiting and dyspepsia X-rays showed gall-stones	Gall-stones (by X-ray)	Operation, 10 Aug. 1950. Thick gall-bladder adherent to liver—perforated, single stone lying free in a subphrenic abscess; drained. P.M. showed an ulcerated adenocarcinoma of gall-bladder infiltrating liver and duodenum	1 stone	11 Aug. 1950
14	A.McD.	F.	72	7 Sept. '50	Operation No P.M.	7 days continuous vomiting 3 months intermittent vomiting 2 stone loss of weight in 3 months	Distended stomach; pyloric stenosis	Operation, 15 Sept. 1950. Large hard mass replacing gall-bladder infiltrating liver. Ulceration into duodenum and fistula with local perforation, and pus in local abscess	Nil	4 Oct. 1950

Patient		Sex	Age	Date of Admission	Diagnosis Procedure	Main Symptoms	Main Signs	Operation or P.M. Findings and Investigations	Presence of Stones	Longevity Date of Death
15	A.M.	F.	62	31 Mar. '51	Operation No P.M.	2 months Jaundice Patient stated she only wanted to eat beans	Jaundice Ill-defined abdominal mass	Operation, 4 April 1951. Hard craggy gall-bladder. Massive secondary growths in portal fissure obstructing common bile duct	Nil	17 April 1951
16	S.F.	F.	73	24 July '51	Operation No P.M.	1 month Jaundice Nausea and vomiting 2 weeks 1 stone loss of weight in 1 month	Jaundice Hard enlarged liver	Operation, 30 July 1951. Hard mass replacing gall-bladder. Secondary growths in liver and pelvis.	Nil	22 Oct. 1951
17	A.S.	F.	64	1 Dec. '51	Operation No P.M.	7 years Diabetes 5 weeks right sided abdominal pain 1 stone loss of weight in 1 month	Mass in right hypochondrium	Operation, 2 Dec. 1951. Gall-bladder thick walled and distended. Liver—many secondaries. Biopsy-adenocarcinoma of gall-bladder	Nil	5 Jan. 1952
18	R.McD.	M.	58	12 Nov. '51	Operation No P.M.	1 week jaundice 1 week anorexia, nausea and vomiting	Tender localized central abdominal mass	Operation, 1 Dec. 1951. Thick gall-bladder adherent to and perforating transverse colon—large local abscess drained	Several	24 Feb. 1952
19	M.G.	F.	89	5 Jan. '52	Operation P.M.	15 months known to have gall-stones —by X-ray 1 week constipation and meloona	Localized tender abscess	Operation 6 Jan. 1952. Dense mass—gall-bladder adherent to adjacent structures; local perforation and abscess formation. Drained P.M. Carcinoma infiltrating liver. Nodular secondaries in liver	Several	13 Jan. 1952
20	A.R.	M.	65	7 May '52	Operation No P.M.	Duodenal ulcer 12 years 5 months indigestion 1 stone loss in weight in 1 month X-ray—gall-stones	X-ray—gall-stones	Operation, 8 May 1952. Thick walled gall-bladder full of stones infiltrating liver. Secondaries in local and hilar lymph nodes.	Several	May 1953 ?
21	R.McG.	F.	60	27 Apl. '53	Operation P.M.	2 months flatulent dyspepsia and vomiting 23 years before had perforated duodenal ulcer sutured	Local tender right subcostal mass	Operation, 30 April 1953. Gall bladder hard and infiltrating liver. Widespread deposits in mesentery and omentum. P.M. adenocarcinoma in fundus locally infiltrating the liver	Several	17 May 1953
22	G.McG.	M.	66	14 Feb. '54	Operation No P.M.	3 years right upper abdominal pain ½ hour after meals, relief by alkalis 2 months increasing jaundice	Local tenderness right subcostal region	Operation, 16 Feb. 1954. Hard massive mass. Metastases in porta hepatis	Nil	Discharged Untraced
23	M.P.	F.	48	5 Jan. '54	Operation No P.M.	5 years right subcostal flatulent dyspepsia 4 days jaundice	Local right subcostal tenderness	Operation, 7 Jan. 1954. Carcinoma infiltrating liver with hepatic metastases	Nil	8 Jan. 1954
24	M.H.	F.	58	2 May '54	Operation No P.M.	3 years right sided biliary colic 1 stone loss of weight in 4 months	X-ray—gallstones	Operation, 11 May 1954. Gall bladder removed easily. No external evidence of abnormality. *Path. Report*: Papillomatous mass at fundus. 3 cms. in diameter—adenocarcinoma	1 stone	Discharged 18 May 1954 Still alive
25	J.R.	F.	69	18 Mar. '54	P.M.	6 months loss of energy 4 months anorexia 2 weeks epigastric pain 3 days jaundice	Emaciation Abdominal mass Jaundice	P.M.—Carcinoma of fundus infiltrating and ulcerating into duodenum. Massive metastases in porta hepatis	2 stones	7 April 1952
26	J.N.	M.	84	14 June '54	P.M.	10 years biliary colic 2 months loss of weight and jaundice	Jaundice Upper right abdominal mass X-ray gall-stones	P.M.—Carcinoma of fundus, ulcerating; local infiltration into liver substance. Gall bladder full of stones. Liver, many white secondaries	Several	17 June 1954
27	M.K.	F.	70	6 Oct. '54	Operation No P.M.	3 months anorexia 2 weeks jaundice 1 stone loss of weight in 2 months	X-ray opacities in gall-bladder site	Operation, 15 Oct. 1954. Thick gall bladder adherent to liver. Extensive metastases	Nil	20 Oct. 1954

TREATMENT

In the absence of adequate means of making a positive pre-operative diagnosis, the surgeon is more often than not presented with the disease at laparotomy.

In 1947 Sheinfield made an extensive study of all the recorded cases that had been subjected to any form of operative procedure. He reproduces a comprehensive tabulation of all the cases treated by cholecystectomy, with, or without, a partial excision of the liver.

Of a total of 417 cases diagnosed, 284 were submitted to operation, and 157 had a cholecystectomy performed. Survivals were 16 for 5 years, 3 for 4 years, 4 for 3 years and 2 for one year.

The writer concluded that where possible, when indicated, a local liver resection may prove of definite palliative, if not even of curative, value. The results in general are poor as compared with similar radical procedures utilized in the surgical treatment of malignant tumours in other parts of the body.

No mention is made of the use of deep X-ray therapy. It is to be hoped that the introduction of newer methods of cholangiography may assist in the earlier diagnosis of the disease, enabling the surgeon to operate on cases either before they have spread extensively, or prepare for a major abdominal procedure at laparotomy-resection of the liver.

ANALYSIS OF CASES

An analysis is made of the 27 cases recorded over the years 1944-1954 at the Dunedin Public Hospital.

General findings

The disease was found at laparotomy in 22 cases but only two were operable. The carcinoma was associated with gall-stones in 12 cases (of which 3 had a single stone). A summary of the features is given in Table 5.

SUMMARY

1. Carcinoma of the gall-bladder is thought to be a rare disease.
2. The diagnosis should be considered in those cases of known gall-bladder disease when the pain or "flatulent dyspepsia" is becoming more constant, there is the appearance of anaemia, or jaundice or an unexplained progressing loss of weight.
3. It is to be hoped that the newer methods of visualization of the biliary apparatus by radiography may lead to the earlier diagnosis of the disease.
4. A critical clinical survey is made of 27 cases recorded at the Dunedin Public Hospital over the years 1944-54.

ACKNOWLEDGEMENTS

We wish to thank the Professor of Pathology, Dr. E. F. D'Ath, Professor M. F. Woodruff of the Department of Surgery, Professor H. Smirk of the Department of Medicine, and the Honorary Physicians and Surgeons of the Dunedin Hospital for permission to publish the clinical case histories and operation or post-mortem findings.

We are indebted to Mrs. Lemon and Mr. Brook of the Photographic Department of the Dunedin Hospital for their photographs.

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THE TREATMENT OF PILONIDAL SINUS

By Daniel Lane

Brisbane

"Be not the first by whom the new are tried,
Nor yet the last to lay the old aside."

—Pope

THE treatment of pilonidal sinus has passed through many and varied phases since its original description by Anderson in 1847. The method of treatment has been influenced largely by the aetiological concept in the mind of the surgeon.

The problem of aetiology is intimately linked with the problem of treatment. Is the lesion congenital or acquired? If it is congenital let us be radical in our approach so that no trace of the sinus may remain. If it is acquired then radical procedures are not so necessary and prophylaxis assumes a most important role. In order to arrive at the best method of treatment we must have the correct aetiological concept. Let us then proceed from aetiology to treatment.

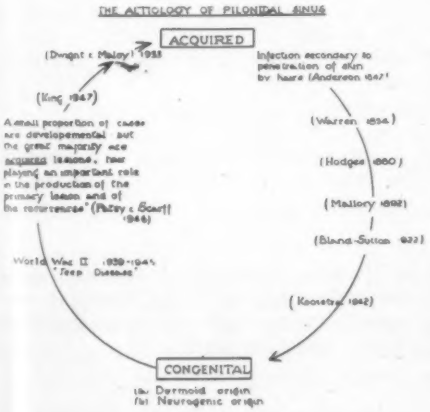
THE AETIOLOGY OF PILONIDAL SINUS
ACQUIRED
(Dwight & Maloy) 1953
Infection secondary to penetration of skin by hairs (Anderson 1847)
(King 1947)
(Warren 1854)
A small proportion of cases are developmental but the great majority are acquired lesions, hair playing an important role in the production of the primary lesion and of the recurrences (Patey & Scarff 1946)
(Hodges 1880)
(Mallory 1892)
(Bland-Sutton 1922)
World War II 1939-1945 "Jeep Disease"
(Kooistra 1942)
CONGENITAL
(a) Dermoid origin
(b) Neurogenic origin

FIG. I

Aetiology

The original writers on the subject, Anderson (1847) and Warren (1854), considered the lesion to be acquired. Hodges (1880) was amongst the first to uphold its congenital origin. He considered three aetiological factors as essential, namely, a congenital coccygeal dimple, abundant hair development and insufficient cleanliness. Later, Mallory (1892), Bland-Sutton (1922), Kooistra (1942) and many others added strong support to the congenital theory of origin. With the advent of the Second World War the increased incidence of pilonidal sinus complications stimulated further research into the problem of its aetiology and treatment.

During recent years the work of Patey and Scarff (1946), King (1947) and Dwight and Maloy (1953) has compelled us to consider the lesion as an acquired one. The wheel has turned a full circle.

The congenital theory holds that pilonidal sinuses represent remnants of the neural canal or that they are due to inclusion dermoids. The acquired theory considers that the majority of sinuses are due to "some combination of stiff hair, tender or macerated skin, poor hygiene and possibly repeated trauma" (Dwight and Maloy, 1953).

The main arguments put forward by the two schools of opinion are summarized:

	Ante-Natal (Congenital)	Post-Natal (Acquired)
Site	It is a common site for developmental defects. Serial sections of human embryos lend strong support.	The pilonidal sinus occupies a unique position readily explicable on the basis of poor hygiene, hairs and trauma.

Sex	
Some of the patients are females who are usually hairless in this part and as a rule more clean in their personal habits than men.	Males with hairy buttocks predominat 5:1. This cannot be explained on a con genital basis.
Occupation	
Trauma may aggravate the underlying condition.	Trauma is important in the initiation and in recurrence, for example, in "Jeep Disease."
Age	
The condition usually occurs in young adults which is in keeping with the congenital theory, as in branchial cysts and fistulae.	Young adults, especially males, are more prone to sweat and production of sebaceous secretion and to undergo trauma to the area. Why should a congenital lesion predominantly affect the male sex and manifest itself chiefly in the 2nd and 3rd decades of life?
Uninfected dermoid cysts in the post-anal region	
These may be found especially in infants but, we must admit, they are usually found much closer to the rectum than the usual pilonidal sinus.	These are very rare in adults. If they are the usual precursor of pilonidal sinus, why are they not more common?
Hair in the sinus	
This is found in at least 50 per cent. of cases which is in keeping with the dermoid idea. We must admit that the hair is usually stiff and not the soft downy hair usually found in dermoid cysts elsewhere.	This may just as easily be acquired either primarily or secondarily. The stiff hair is usually lying loose and therefore not arising in the sinus wall. Epilation doses of X-ray have reduced recurrence rate.
Hair follicles	
These are found in the sinus wall and thus support the dermoid theory.	These can be found in only 9 per cent. of cases and even some of these may be implanted.
Epithelium	
It can be found lining many of these sinuses. In a proportion of cases it has been replaced by granulation tissue in the deeper parts of the track.	It often grows down chronic sinuses. A complete epithelial lining is most uncommon in the true pilonidal sinus and therefore it is not congenital.
Sebaceous glands	
These are occasionally found in the wall of the sinus and further support the developmental theory.	These are extraordinarily uncommon in the sinus walls and therefore cannot lend useful support to the congenital theory.
Recurrences	
These are due to incomplete excision of the original track. Kooistra (1942) states: "It is obvious from the pathology that any form of treatment to be successful must	In many cases these cannot possibly be due to incomplete excision. The recurrent sinus may even be larger than the primary sinus. The histology of recurrences is

completely eradicate the cyst and sinus and all granulation tissue."

identical with that of the primary lesion even in cases where incomplete excision of the primary sinus could be precluded. Recurrences are due to mechanical factors caused by collection of hair in an imperfect scar.

Pilonidal sinus in the hand and axilla

These may be inclusion dermoids, but they are difficult to explain.

Their occurrence is in perfect accord with the acquired theory.

Treatment by simple incision and packing

This has been successful in a limited series of cases but it is too early to make final pronouncements.

This is successful for the same reason that it is successful in fistula-in-ano. If the condition were congenital in origin this method would be doomed to failure. Buie (1944) first reported successful results by using this simple method. Complete excision is unnecessary, time consuming and uneconomical.

Conclusion

The lesion is essentially congenital being either an inclusion dermoid or due to caudal remnants of the medullary canal. These defects lie dormant until infection supervenes and as a result the epithelial lining of a varying portion of the cyst is destroyed, thus explaining why, in many cases, the greater part of the track is lined by granulation tissue.

Mechanical factors may help to initiate infection but cannot possibly cause the original condition.

Treatment must be radical as the commonest cause of recurrence is incomplete removal of the cyst or sinus.

The lesion is very difficult to explain by either theory of congenital origin. Pathological evidence distinctly favours the acquired theory. On the basis of age, sex, mechanical factors, hair and lack of hygiene, it is easier to explain the origin of the condition and the real reason for recurrence.

If the condition is largely an acquired sinus, resulting from a foreign body reaction around hairs which enter from neighbouring skin, we must direct much of our attention to prophylaxis.

Simple treatment is quite adequate and has many advantages over the radical methods still in vogue.

As King (1946) has emphasized, the small sinus may arise as a result of widening of a hair follicle. This is the only type of sinus in which hair may be found growing in association with sebaceous glands. Multiple sinuses may simply represent stages in development.

We cannot deny that some pilonidal sinuses may be of congenital origin. Those sinuses showing some connection with the spinal canal undoubtedly are, but in the vast majority of cases the sinus is acquired and is a foreign-body reaction around hairs which enter from the neighbouring skin.

TREATMENT

As a result of the change in our concept of the aetiology of the sinus we must review our present methods of treatment. Many volumes have been written on the topic and yet no general agreement has been reached.

Most surgeons today practise radical excision of the sinus and its ramifications. The wound is generally left widely open and eventually nature completes the cure after some months. Even then, complications arise and further operations upon the unfortunate sinus bearer may be required. Such a method

means much discomfort and loss of working hours. In the Armed Forces the problem of pilonidal sinus is of major importance when viewed in the light of disturbed economy and loss of service.

Various methods of primary closure have been invented to overcome these problems. Shute *et alii* (1943), using a method of primary closure, reported that 90 per cent. of 59 cases healed in an average time of eleven days. Davies and Starr (1945) could claim similar results using the Estlander rotation flap for primary closure. However, these methods are not perfect and when complications arise lengthy treatment is involved.

Usually there is a simple solution to most surgical problems and frequently "the simpler the better," especially when used by the average general surgeon who operates only occasionally on pilonidal sinus.

I have indicated the approach to treatment in Fig. II. Let us presume that most of us are general surgeons who seek a simple and effective solution to the annoying problem of pilonidal sinus. Wherein lies the answer? In a certain number of cases the sinus presents itself as an abscess. It has been taught that these should be drained and when the acute infection has subsided, the sinus should be widely excised.

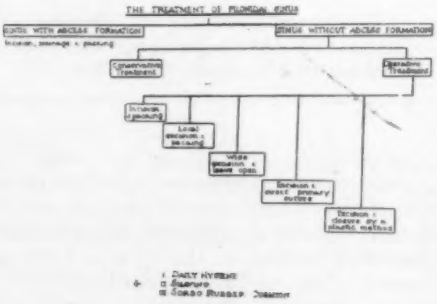

FIG. II

Hodges in 1880, writing on the treatment of such abscesses stated, "If it is gently opened and the lock of hair removed, the sinus fills up with new tissue and in due time heals by solid cicatrix." As Dwight and Maloy (1953) have recently shown, incision and packing alone will cure 93 per cent. of such cases.

It is important that a midline incision be employed regardless of whether the abscess is pointing there or laterally. This incision should be extended to include all midline sinus openings whether they are in the inflamed area or not. Obvious hair and debris should be removed. The wound should be packed loosely rather than kept open by a drain. Chloromycetin (5 per cent. in propylene glycol) is of value for local application. In some cases parenteral antbiotic therapy is indicated. Packing is continued until the wound is healed. This should rarely exceed 8 weeks.

If the patient presents with a deep chronic sinus and if there have been many attempts at operative cure and no great inconvenience is being caused by the sinus, there is something to be said for leaving things alone.

A pad with or without some local antiseptic, frequent baths and a soft rubber cushion may be more satisfactory than another operative "cure" suggested by an enthusiastic surgeon to a doubtful patient. Sometimes the surgeon is tempted to accept the difficult challenge and adopt the "press on regardless" attitude which often opens up new pitfalls. The pilonidal sinus causes great inconvenience but it rarely threatens life.

For the sufferer who is anxious for operation one can occasionally use excision and primary closure with an excellent result. On no account should simple primary closure be performed if there is undue tension on the suture lines or if absolute haemostasis and obliteration of all the dead space remain doubtful. Complicated plastic methods of closure seem unnecessary and hardly justifiable. In the vast majority of cases simple local excision and packing or incision alone plus packing will give a 90 per cent. cure rate.

The method illustrated in Fig. III is a simple one which is of value in the smaller sinuses to be totally excised. Using this method the patient becomes ambulatory immediately and is usually ready to return to work after 5 to 6 weeks. The carbolic acid has a twofold purpose: to control infection and to destroy the unhealthy granulation tissue lining. If some portion of the tract

remains after excision, it will usually not delay healing unless some hair has also been overlooked.

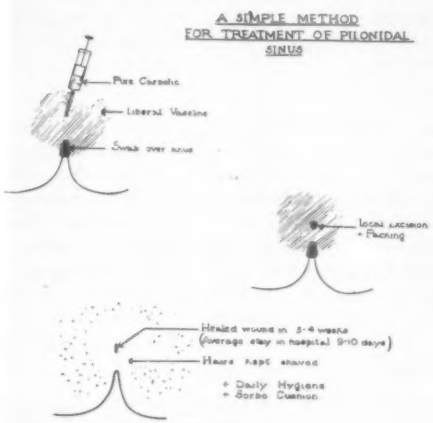

FIG. III

If incision and packing is to be used then we must adhere to certain basic principles. Dwight and Maloy (1953) advise that all hair and debris must be removed, unhealthy looking granulation tissue wiped away with gauze, and the skin edges accurately trimmed to avoid overhanging edges. The wound is packed loosely, early ambulation encouraged, and warm baths taken daily a few days after operation. The majority of these wounds remain comfortable and will be healed within 6-8 weeks. The general success of this method of treatment will depend upon the correct design and care of an open wound. Let us then return to the basic principles of surgery in order to conquer this annoying condition.

There is another advantage in using these simple methods of treatment and that is if recurrence should develop the patient can be advised that no great inconvenience or time loss will be caused by further operation and yet the chances of success are as high, if not higher, than with more complicated methods.

SUMMARY

This brief review has been written in order to stress the importance of certain aspects of pilonidal sinus not generally accepted. The orthodox teaching in most centres has been to accept the congenital theory of origin for pilonidal sinus. Nowadays the pendulum is swinging back to its starting point and many of us are beginning to accept the acquired theory. The bulk of pathological and clinical evidence favours an acquired theory of origin.

If the acquired theory is correct then we must review our approach to treatment. Prophylaxis becomes increasingly important. Simple methods of treatment, such as have been described, are quite successful and have many obvious advantages to offer. We must relearn the correct design and care of an open wound.

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INTRAMEDULLARY FIXATION OF THE LONG BONES

By Peter Williams

Melbourne

THE modern technique of medullary nailing was introduced about fifteen years ago and in the interim has been extensively practised in most parts of the world. Now that the initial flush of enthusiasm has passed it would seem opportune to review the subject and attempt to define its indications, advantages and limitations in the light of current experience.

This report is based on the lessons learnt in a personal series of 45 cases.

History

The history of the subject is probably well known but it is interesting to recall that the earliest report appeared nearly sixty years ago and in 1916 Hey Groves described a method for fractures of the femur, humerus and ulna which differs little from the present-day technique.

It remained for Kuntscher during the Finnish War to elaborate the Cloverleaf and V-shaped nails which he introduced without exposure of the fracture site; this closed method is still practised and preferred on the continent of Europe, where the fear of infection still seems to influence much of their work in fracture surgery.

Kuntscher wrote that intramedullary fixation was the treatment of election in all fractures, but though at the present time few would agree continued experience has shown that the method has a limited and very useful application.

Advantages of Medullary Fixation

Perhaps the greatest virtue of medullary fixation is that properly carried out it provides more efficient immobilization than any other form of metallic fixation. As a corollary to this, external fixation (at least in the femur) is not usually necessary, hence neighbouring joints can retain their mobility and the patient is spared the necessity of cumbersome plasters and long periods of hospitalization. The nails can be easily removed through a small incision without exposure of the fracture site or, on the other hand, they may be left if for long periods in fractures which unite slowly, or, in the treatment of non-union. In pathological fractures of the femur and humerus an intramedullary nail will often provide comfort for the patient's period of survival.

Although Kuntscher stated that the presence of the nail stimulated the production of callus, this is not always the case. In my experience, over-abundant callus formation has been the rule only in those cases in which no external fixation was used and in which it was suspected that the nature of the fracture line allowed some rotational movement to occur. In femoral fractures callus formation is always least in completely stable transverse fractures and maximal in comminuted fractures where no external fixation is used. In fact it appears that if a plaster spica can be avoided, despite the movement which must occur, union occurs more rapidly. Sometimes the volume of callus is extraordinary.

Certainly the amount of external callus formed is always far in excess of that seen in comparable fractures with plate fixation and usually greater than in those treated conservatively.

When union is long delayed in femoral fractures, or if non-union is present, simple freshening of the fracture surfaces and fixation with a nail appears to be sufficient to secure union. Although I have applied this technique to only a small number of cases, union was obtained quickly in all without the use of supplementary bone grafting. On several occasions locally available bone fragments were packed around the fracture and these were soon incorporated in the new callus.

Recently Kuntscher nailing of the femur has been advocated for un-united and septic gunshot wounds of the femur. Although this would seem to transgress established surgical principles, a recent series reviewed in the American literature showed that union will occur and sepsis be controlled in a considerable proportion.

INDICATIONS

The main purpose of this paper is to make certain observations on intramedullary fixation in fractures of the femur. However, for the sake of completeness I propose to deal briefly in the first instance with the application of the method in other sites.

Fractures of the humerus

(1) Fractures of the surgical neck of the humerus occur at all ages. In children operative treatment of any sort is rarely required as a poor standard of reduction is compatible with an excellent end result.

At the other extreme, when these fractures occur in the elderly, operative methods are again contra-indicated, but in younger adults one is occasionally obliged to resort to open methods of reduction. When this becomes necessary intramedullary fixation can be used to great advantage. These fractures, when reduced, are often intrinsically unstable, and other forms of internal fixation such as plates and oblique screws are either technically impossible or imperfect. Here as in other situations unless the internal fixation is secure, early movements cannot be instituted with reasonable safety—all the advantages of operation are lost and permanent stiffness is the all too common sequel.

(2) Fractures in the shaft of the humerus sometimes call for treatment by open methods. Apart from the usually accepted indications I believe that all cases associated with complete radial nerve palsy should be so treated. The gross state of the nerve can be discovered and appropriate treatment given while at the same time the fracture can be reduced and secured. Many months of fruitless waiting for recovery will be avoided when partial or complete severance of the nerve has occurred.

Any metallic fixation applied to the humeral shaft, to a greater or lesser degree, seems to be associated with delayed union. Intramedullary fixation is no exception to plating but in both cases it is wise to onlay the fracture site with cortical slivers obtained from the adjacent bone.

(3) Pathological fractures of the upper 2/3rd of the humeral shaft, so common with the metastases of mammary cancer, are most satisfactorily treated by intramedullary fixation; this not only provides relief from pain but may be favoured by union.

(4) In the lower 1/3rd practically the only indication is the so-called "baby car" fracture. Early movement of the elbow which is so essential can only be obtained when the humeral fracture is secured and a nail introduced through the lower fragment fulfils this objective.

TECHNIQUE

In general the technique is similar to that used in the femur, but certain modifications are worthy of mention. First, V-shaped nails with a bevelled end are preferable to those of Cloverleaf section and it is unnecessary to use nails which traverse the whole length of the medullary cavity.

In fractures of the surgical neck it is usually easier to reduce the fracture under vision and, after making a suitable hole in the humeral head between the greater tuberosity and articular cartilage, the nail can be hammered past the fracture site until its head is flush with the bone.

In fractures of the shaft the nail can be introduced in the retrograde manner — the technique being similar to that used for the femur. In fractures of the lower 1/3rd, the nail is introduced through a small trough cut with an osteotome just above the olecranon fossa and passed upwards.

Forearm fractures

Internal fixation is sometimes required in fractures of the forearm bones either as the procedure of election in certain types or when it has been impossible to obtain or retain reduction by closed methods. As regards the first group, I think that all displaced fractures of the olecranon and all Monteggia fracture-dislocations are more sasisfactorily treated in this way. Plate fixation in the

forearm carries the serious disadvantage that in over 50 per cent. of cases union is either very delayed or proceeds to non-union, so that secondary bone grafting becomes necessary. After intramedullary fixation, however, union is more rapid and so far I have not yet had a case in which non-union developed.

The method comes into its own in the treatment of those complicated compound fractures of the right elbow which seem to be occurring with increasing frequency.

In these cases the first essential aim, as in all compound fractures, is to obtain primary skin healing and this is often defeated by the fragments of the ulna angulating towards the surface and emerging through the sutured wound or the split skin graft covering. Intramedullary fixation of the ulna is often the deciding factor between success and failure.

MATERIALS AND TECHNIQUE

Olecranon: Although various devices can be used successfully it would appear that the most reliable is a long lag screw of suitable diameter. The medullary cavity of the ulna is very narrow and the bone of ivory hardness so that it must be carefully drilled out to the root diameter of the screw.

Shafts: Fractures of the upper 1/3rd of the ulna are best secured with a small V-shaped nail introduced according to the technique described for the femur, and ordinary commercial high speed twist drills 6 inches long are ideally suited for this purpose.

Fracture of both bones once reduced at operation are often sufficiently stabilized by a heavy Kirschner wire passed along the ulna only and left protruding through the skin over the olecranon. This allows the plaster to be applied with relative ease and the wire can be removed three weeks later without removing the plaster.

If necessary the radius too can be stabilized by a wire inserted through the radial styloid and directed upwards.

The use of Kirschner wires in this way is particularly useful in childhood fractures.

Fractures of other bones

Intramedullary fixation has been widely used especially in the United States for the fractures of the tibia, phalanges, metatarsals and clavicle. As regards the tibia I have had no personal experience of the method but feel that the plate fixation, when indicated, is so satisfactory (especially when re-inforced with sliver grafts) that the known disadvantages of the intramedullary method in this situation scarcely justify its use.

In the short long bones a good functional result can nearly always be obtained by conservative methods.

Fractures of the femur

Most fractures involving the shaft of the femur can be treated satisfactorily by conservative methods. I say satisfactorily, by which I do not mean efficiently, for I do not believe that any method involving three or four months discomfort in hospital and the likelihood of a stiff knee can be called efficient.

(1) However, fractures involving the upper 1/3rd of the shaft must be placed in a special category for, inaccessible as they are to manipulative reduction, reliance must be placed on traction and this almost always results in a poor standard of reduction. Union is very delayed, late varus angulation the rule and re-fracture on beginning weight bearing an all too common sequel.

Kuntscher nail-fixation provides an easy solution to the treatment of these fractures and should be regarded as the treatment of choice. If carried out soon after injury the operation presents little difficulty and the patient can be mobilized early and rapid union anticipated. While transverse and short oblique fractures are the obvious choice for this method, long oblique and even segmented and comminuted fractures can be successfully treated. If internal fixation is delayed until conservative treatment has failed the operation can be extremely difficult and demand a degree of physical effort more appropriate to a wrestling match than a surgical performance. Often end-to-end apposition can only be obtained by accepting some shortening.

(2) Fractures involving the middle 1/3rd of the femur are more easily treated conservatively than their higher counterpart, but when reduction cannot be obtained or if the

patient is unmanageable because of head or other injuries intramedullary fixation is highly desirable and is superior in its results to plate fixation. The limited exposure of the fracture site does not seem to carry hazards of subsequent knee stiffness so common after the use of plates.

Provided the fracture is stable or can be made so by nailing, there are many reasons for regarding this method as the one of choice, even in the middle 1/3rd fractures. If a "spica" is necessary to supplement the nails in very comminuted fractures some of the advantages of the method are lost.

(3) Fractures of the lower 1/3rd are unsuitable for medullary fixation for the nail has too insecure a grip on the distal fragment.

OPERATIVE TECHNIQUE

In order to properly understand the operative technique it is necessary to recall that the medullary cavity of the femur can only afford fixation for a nail at its isthmus which lies in the middle 1/5th of the bone. Elsewhere the medulla is very capacious and even the widest nail will be a very loose fit. It follows, therefore, that in all fractures of the upper 2/3rd of the shaft the nail must enter the cancellous bone of the condylar region. When this is achieved the nail will have a firm grip in three places — the upper surface of the neck, the isthmus and in the condylar region.

(1) Prior to operation X-ray photographs are taken which show the whole of the shaft of the fractured femur. On two occasions I have operated on upper 1/3rd fractures and have had the mortification of finding further fractures in the lower 1/3rd.

Before the patient is postured, the length of the normal femur is measured with a tape from the tip of the trochanter to the joint line of the knee. If one and half inches is subtracted from this figure it will provide a nail length which will extend from just above the trochanter to within a $\frac{1}{2}$ inch of the intercondylar line of the knee.

(2) Instruments required:

(a) Two full sets of $\frac{3}{8}$-inch and $\frac{7}{16}$-inch nails.

(b) Drills and brace.

(c) Extractor.

(d) Hey Groves forceps.

(e) Two pairs of pliers.

(f) Heavy stainless steel wire.

(g) Wire cutters.

(3) Calibre of nail: Only stainless steel nails of Cloverleaf pattern with an extractor eye at each end have been used and I consider that any calibre less than $\frac{3}{8}$ inch is worthless. Indeed I have made a practice of using $\frac{7}{16}$-inch nails routinely in all male patients and in many females also. In some fractures in the very elderly the medullary cavity is so large that it is necessary to use two interlocking nails as described by Charnley (1952). However, if two nails are used especially in long spiral fractures, care must be taken that the bulk of the nails does not prevent the fracture surfaces coming into apposition. Most spiral fractures require one or two encircling wires to render them stable.

(4) Exposure: The patient is postured in the Sims position with the affected thigh uppermost. In the upper 1/3rd the fracture site is exposed through a lateral muscle-splitting incision, whereas in the middle third a postero-lateral approach turning the vasti forwards off the lateral intermuscular septum is preferred. Reflection of muscle is carried out to a minimum — the wound being coned down to the fracture site.

(5) Operation: The proximal bone end is withdrawn with a hook and grasped with a pair of Hey Groves self-retaining forceps and cleared of muscle debris. The medullary cavity is now reamed out with a suitably sized Cleveland drill until its point is felt to emerge through the upper surface of the femoral neck. As a rule a $\frac{7}{16}$ drill is used for a nail of similar size, but if the nail proves to be more than a push-fit the cavity is enlarged with a $\frac{1}{32}$-inch oversize bit.

The selected nail is now introduced head first into the proximal fragment and hammered in until it appears under the skin of the buttock. A small incision here will allow the nail to continue until about a $\frac{1}{2}$ inch is visible beyond the fracture. Next the distal fragment is delivered, held and drilled to

beyond the isthmus. By angulation and traction the distal fragment can now be reduced over the protruding end of the nail and having checked the rotation of the fragments the nail is hammered home.

Spiral fractures, however, must first be accurately reduced and held with bone clamps while the nail is hammered past the fracture.

In comminuted fractures the fragments are painstakingly assembled and as more and more of the medulla is reconstituted the nail can be advanced inch by inch. When the nail is almost fully home a check X-ray of the whole femoral shaft is taken to ensure that the nail has not wandered outside the medulla. It may now be necessary to advance or retract the nail a little and when this has been done a final X-ray photograph of the knee region is taken before the wound is closed.

In cases of non-union, where significant shortening is established, no attempt should ever be made to overcome this on a traction table at the time of operation as peripheral gangrene will almost certainly follow. Length can often be restored, however, if manual osteoclasis is followed by strong skeletal traction over a period of weeks prior to operation.

Bone grafting of these cases is unnecessary unless a large deficiency or excessive sclerosis is present, but in all cases a few locally obtained cortical slivers can be onlaid to reinforce the union.

(6) After care: Knee movements can commence almost immediately and a full range can usually be obtained by the end of the second month. The aftercare of the fracture is dictated solely by the observations made of the stability of the fracture at the conclusion of the operation.

(a) Transverse and short oblique fractures with interlocking spikes which prevent rotation are allowed up in a weight bearing caliper as soon as the wound is healed.

(b) Long oblique and spiral fractures are best kept in recumbency for 4-6 weeks when there is usually sufficient callus formed to allow walking in a caliper to be free from risk.

(c) Very comminuted fractures where encircling wires have been used to secure loose fragments are sometimes safer in a plaster spica applied at operation and retained for 6-8 weeks. Usually it is sufficient to rest the leg in a Thomas Splint for about the same length of time.

The fracture line is often visible up to six months from the time of operation but calipers can be discarded as soon as X-ray films reveal a continuous bridge of external callus. This is nearly always the case within three months.

DISADVANTAGES AND COMPLICATIONS

There never has been and probably never will be any procedure in fracture surgery which has been associated with so many fearsome complications.

(1) Those associated with the closed nailing method can be disregarded for it is felt that apart from its inherent difficulties, it carries such a grave risk of radiation burns both to the patient and to the surgeon, that it should be condemned out of hand. The Continental literature abounds with case histories illustrating difficulties and disasters encountered during closed nailing and even death during the operation has been a not uncommon sequel after monumental struggles lasting four hours or more.

By the open method very few operations will fail to be completed within the hour and many can be carried out in half this time. Operative shock is rare and all but the more complicated fractures of the femur can be nailed without blood transfusions.

(2) Sepsis is perhaps the most serious of all complications. Any method of fracture treatment which converts a closed fracture into an open one must offer very definite advantages to make this risk justifiable. I believe that intramedullary fixation does, and the fact that no cases of sepsis occurred in the series under review seems to justify this view.

(3) Impaction of the nail is the most dreaded complication. When this paper was first prepared I wrote that impaction was impossible if preliminary drilling of the medullary cavity was practised.

Time, however, was to prove this statement to be over-optimistic for, several months ago, I had the mortification of jamming a ⅜-inch nail in a femur previously drilled to ⅜ inch after it had entered a mere three inches. Two hours later after the extractors had stripped and the head fallen off the mallet the offending metal was finally removed by making a longitudinal saw cut in the cortex and spreading this with wedges. As there did not seem any logical reason for this mishap the medulla was drilled out to ⅞ but a ⅜-inch nail again started to jam at the same point. The operation was finally abandoned and a reasonable result subsequently obtained in a balanced traction. I would be indeed grateful for any explanation of this phenomenon.

(4) Penetration of, or interference with, the function of neighbouring joints is avoided by choosing nails of correct length and the use of X-ray control at the time of operation.

(5) Paget's disease requires special mention, for fractures occurring in this condition provide the only exception to the rule of full-length nailing. In upper 1/3rd fractures a short nail must be used as any attempt to introduce the nail much beyond the point of maximum convexity will result in either an impacted nail or its extrusion through the lateral cortex.

If the fracture is near the mid-shaft the difficulty may be overcome by bringing the upper end of the nail out lateral to the trochanter.

Advantage can be taken of the fact that the medullary cavity in Paget's disease is nearly always placed eccentrically so that some of the excess cortex on one side provides a lucrative source of sliver grafts to onlay around the fracture.

Although it is commonly stated that fractures of the femur in Paget's disease "unite like wildfire," the exact reverse often occurs especially in the advanced stage of the disease. The results of nailing are particularly gratifying and present no particular technical difficulties.

(6) Bending of the nail is due to poor quality metal, insufficient calibre or unprotected weight-bearing in the early months. All these factors are under the control of the surgeon. One young man thought his leg felt so well that he walked out of hospital two weeks after operation without even taking a stick with him. When the leg became uncomfortable several days later, however, he willingly returned. X-rays showed that his oblique fracture had telescoped a little but union followed quickly with some shortening.

The position is summarized by Watson Jones who states "this technique if applied to improperly selected cases, or if inefficiently or unsuccessfully carried out offers more possibility of trouble than any other." However, given the correct indications and instruments and adhering rigidly to a few simple rules a surgeon experienced in the method will rarely encounter complications.

RESULTS

Thirty-four cases of fractures in the upper 2/3rd of the femoral shaft have been treated by Kuntscher nailing. There were three deaths within the first month of operation, none of which was directly attributable to the operative procedure.

Analysis of 31 cases

(1) Indications:

Elective	18 cases
Early re-fractures	4 cases
Inability to reduce	4 cases
Non-union	5 cases

(2) Complications:

Sepsis	Nil
Fat embolism	Nil
Impacted nail	1 case (See text)
Malunion	1 case
Non-union	Nil

(3) Union: Union occurred in all cases and was considered sufficiently sound to discard the caliper within three months in 26 cases and within four months in 5 cases. Over two-thirds of the patients were ambulant within two months.

(4) Knee movement: Only two patients failed to achieve less than 90° of knee movement.

SUMMARY

1. The place of intramedullary fixation in fracture treatment is discussed.
2. Various improvements in operative technique are described.
3. The end results of 34 patients with fractured femurs treated by Kuntscher nailing are analyzed.

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INTESTINAL OBSTRUCTION

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THIS paper summarizes the findings in 355 cases of intestinal obstruction of all types admitted to the Royal Prince Alfred Hospital between 1st July, 1950, and 31st December, 1953. In particular an attempt is made to analyze the causes of death in these cases and to compare them with those in other published series.

This series of cases occurring in a 3½-year period compares in numbers with those previously reported—most large hospital series have averaged each year about 100 cases of intestinal obstruction requiring attention.

(1) The majority of cases of "strangulated" herniae required reduction rather than resection — 20 of 23 cases (McLaughlin). One third of our own cases required resection. At the same time the mortality in cases requiring resection was as high as, if not higher than, that in our series of cases.

(2) Opening of an abscess figured as an operative procedure for relief of obstruction —no such easy path was found in our cases of obstruction.

(3) Up to 50 per cent. of the cases of adhesive obstruction were not operated on.

Table 1

Date	*Author*	*Number of Cases*	*Mortality*
1925	SOUTTAR	3,064	26%
1932	VICK	6,892	26%
1938	WANGANSTEEN	157	18%
1949	McLAUGHLIN	125	9%
1949	MOSES	223	6.5%
1955	GRAFTON SMITH	1,252	14.5%
1953	Present Series	355	20%
1872	CHARPENTIER	74 (strangulation)	51%

The mortality of intestinal obstruction

The recorded groups of cases since 1925 is summarized in Table 1.

Here it is seen that the mortality in any large series is still high. If we consider the two series in which the mortality is below 10 per cent. (McLaughlin [1949], 125 cases, and Moses [1949], 223 cases), we find:

In our series the only cases of adhesive obstruction not submitted to operation were those in which a prior laparotomy or laparotomies had been done and where the previous diagnosis of adhesions was considered to be sufficient to warrant the continuation of intestinal decompression alone. This proportion of cases managed conservatively holds particularly in Moses' series—

who also states that one reason for his low mortality is an abandonment of the Miller Abbott tube!

(4) Fifteen cases of volvulus are reported in Moses' series without a death. Our cases of volvulus are obviously in a different category, as such a condition entailed a mortality of 60 per cent. in our hands.

with paralytic ileus and also those with mesenteric vascular occlusion; were these included the mortality would have risen to 16-17 per cent. One case in five in this series was not operated on.

One cannot escape the conclusion that the mortality has not altered greatly for the better in spite of low figures in the shorter series of more selected cases.

TABLE 2

ANALYSIS OF THE CASES

	Cases	*Deaths*	*Mortality*
1. Adhesion Obstruction	117	12	10%
2. Hernial "Strangulation"	61	14	20%
3. Colonic Obstruction	37	12	38%
4. Paralytic Ileus	16	3	19%
5. Infarction of Intestine	7	5	71%
6. Intussusception	8	1	12%
7. Volvulus	15	9	60%
8. Megacolon	9	4	45%
9. Miscellaneous (Foreign bodies, imperforate anus)	36	6	16%
10. Impacted Faeces	42	—	—
Total	355	66	19%
Excluding Impacted Faeces	313	66	21%

(5) Malignancy as a cause of intestinal obstruction appears only twice (1 per cent.) in a primary form as a cause of obstruction in Moses' series of 223 cases. Carcinoma of the colon is associated with a 40 per cent. mortality and forms 10 per cent. of our cases.

(6) Further, Moses gives spinal anaesthesia as a cause of his low mortality rate. In our cases spinal anaesthesia was studiously avoided because we fear anuria in the shocked state in which the more seriously affected patients present.

Grafton Smith *et alii* (1955) report a series of 1,252 cases over the 1942-1953 period with an overall mortality of 14.5 per cent. They excluded from this series patients

Obstruction due to adhesions

Obstruction due to adhesions was by far the main cause of intestinal obstruction; most adhesions were the result of appendicectomy or pelvic operations.

Operation was undertaken in all cases. Entire reliance on tube-suction decompression was only considered to be indicated and continued if signs of strangulation were not present and progress was satisfactory clinically and on X-ray examination.

Suction was used alone in re-admitted cases of adhesion obstruction — several times in some instances. These are only listed as single cases.

Strangulation in hernial sacs

Strangulation in external, and less commonly in internal, herniae was the next most common cause of obstruction. In obstruction of this nature resection of bowel was carried out in 30 per cent. of cases—i.e., gangrene or leakage incidence was 30 per cent. The observation that four deaths occurred in cases in which the bowel was considered viable but in which resection was not performed indicates that a greater appreciation of the desirability of resecting doubtful bowel is necessary (2 cases). In two other cases irreversible shock was present post-operatively.

Colonic obstruction

Colonic obstruction was the third commonest diagnosis. Included under this heading were only cases requiring operation for their alleviation. Impacted faeces, included in this series for completeness, was excluded altogether in a consideration of the overall mortality. In these cases with gross distension the death rate was high, many presenting with caecal rupture or gangrene. Volvulus of the sigmoid colon occurred seven times with four deaths—in these cases there were two primary exteriorizing resections with recovery. Megacolon was also associated with a high mortality. Caecostomy had three times the mortality of colostomy in the series, and each death was associated with technical failure in the formation of the caecostomy—either a leakage or failure to decompress the large bowel.

Miscellaneous

The large number of miscellaneous cases included such entities as foreign body obstruction, gall-stone ileus, malrotation, intestinal atresia, imperforate anus, *etcetera*.

Five cases which died with a clinical diagnosis of intestinal obstruction had no confirmatory laparotomy nor post-mortem examination. These deaths are included under "miscellaneous."

ANALYSIS OF THE CAUSE OF DEATH

Causes of death

(a) Peritonitis		18 cases
	Pre-operative	3 cases
	Post-operative	15 cases
(b) Shock		10 cases
	Pre-operative	5 cases
	Operative	2 cases
	Post-operative	3 cases
(c) Pulmonary complications		7 cases
	Pulmonary oedema (hypertension)	1 case
	Aspiration pneumonia	2 cases
	Pulmonary embolism	4 cases
(d) Gross changes in bowel		38 cases

(a) *Peritonitis*

Deaths due to peritonitis were predominant.

These constituted post-operative happenings in the main.

1. Due to leakage at site of caecostomies (3 deaths).
2. Due to spillage at operation.
   (a) Adhesions — 2 cases.
   (b) Obturator hernia — 1 case.
3. Leaking anastomoses — 9 cases.

(b) *Shock*

The next highest group were those who showed shock with peripheral circulatory failure, prior to or during the operation or in the early post-operative period (and did not have peritonitis to cause such a peripheral failure). There were five patients whose pre-operative collapse was not associated with peritonitis.

1. Crohn's disease with gynaecological procedure ten days before.
2. Secondary operation (rupture of wound).
3. Volvulus.
4. Two cases of mesenteric thrombosis.

There were two who collapsed on the operating table.

1. Volvulus.
2. Strangulated ventral hernia.

Both of these seemed to follow soon after the reduction of the strangulation and could have been due to absorption of toxic substances contained within the bowel when circulation was restored or when the toxic substances were milked into the bowel with normal circulation.

Three patients collapsed at a later stage—that is, on return to ward post-operatively; here again a toxic effect may be postulated or possibly a suprarenal failure. Although these failed to respond to noradrenalin, several of more recent cases have responded to a combination of adrenal cortical extract or cortisone and noradrenalin.

It would appear, in three such shocked cases, which had bowel of doubtful viability (not resected) that such could have had toxic absorption. Where bowel resection had been carried out (unless gangrene of the anastomosed ends occurred) it would seem that an adrenal failure was the basic factor.

In these cases no unequivocally favourable response semed to follow the exhibition of anti-gas gangrene serum.

(c) *Pulmonary incidents*

Pulmonary incidents accounted for 7 deaths.

1. Collapse of the lung — 1 case.
2. Aspiration bronchopneumonia — 2 cases.
   (a) Too early removal of an aspirating gastric tube.
   (b) Failure to diagnose an obstruction at all; an orthopaedic case which developed ileus post-operatively.
3. Pulmonary embolism — 4 cases.

(d) *Gross distension, strangulation or perforation of bowel*

Gross distension (as with colonic obstruction) and gangrene and perforation (in both small and large bowel obstruction) are associated with a high mortality.

This is evidenced by the figures in relation to strangulated hernia requiring resection, infarction of small intestine, megacolon, volvulus and carcinoma of the colon. Here there are a total of 79 cases in which 38 deaths occurred—a mortality of 48 per cent.

It is noteworthy that in 1872 Charpentier reported a series of 74 cases of strangulating obstruction with a 51 per cent. mortality.

TABLE 3

Deaths due to various causes of obstruction giving distension or strangulation; compared with Charpentier's figures.

	Cases	*Deaths*
1. "Strangulated" Hernia	61	12
(a) No resection	43	4
(b) Resection	18	8
2. Infarction of Intestine	7	5
3. Megacolon	9	4
4. Volvulus	15	9
5. Carcinoma of Colon	30	12
1872 Charpentier	74	44

Over-prolongation of suction decompression

Excessive prolongation of suction was the cause of death in three cases. Intragastric suction was used exclusively.

In two of these cases suction was maintained after gastrectomy in spite of an acute episode of abdominal pain and vomiting with rise in pulse rate which persisted after intubation. In both, herniation of small gut through the mesocolic window had occurred with subsequent strangulation and peritonitis.

In the third, herniation of small bowel through the pelvic peritoneal floor occurred on the second post-operative day following an abdomino-perineal resection of the rectum. This was not recognized until a week later, laparotomy revealed the need of resection of strangulated small bowel.

Over reliance on X-ray "scout" film

Reliance on X-ray "scout" film was responsible for faulty diagnosis and death in three cases.

In one case of acute pancreatitis a false diagnosis of true small bowel obstruction was made on the X-ray film. Laparotomy under spinal anaesthesia was followed by anuria and death. In two cases the X-ray failed to

reveal intestinal obstruction. Gas-filled bowel and fluid levels were absent in X-rays of both of these. Strangulated small gut due to mesenteric thrombosis was later found at post-mortem in one. In another, volvulus of a loop of small bowel with strangulation was found at laparotomy.

Specialist mismanagement

In seven cases death occurred whilst cases were being treated in departments other than that of General Surgery and intestinal obstruction was not recognized at all or sufficiently soon to prevent death.

In the Urology Department two deaths occurred:

1. Right renal calculus removed — persistent pain and vomiting post-operatively found to be caused by post-appendicectomy adhesions causing small bowel obstruction.

2. A suprapubic prostatectomy was performed. Post-operatively vomiting and distension were found too late to be due to carcinoma of rectum with secondaries in the liver.

In the Medicals Wards two deaths occurred:

1. A patient admitted to the Medical Ward as a terminal pneumonia and treated as such proved at post-mortem to have a strangulated loop of small bowel prolapse through a hole in the mesentery of the small bowel.

2. A hypertensive patient had vomiting and constipation with abdominal pain for one week prior to death attributed to his cerebral arterial degeneration; but post-mortem revealed gangrenous small bowel due to superior mesenteric artery thrombosis.

In the Orthopaedic Department one death occurred:

A patient had had a per-trochanteric fracture treated by pinning and died due to aspiration pneumonia when she inhaled the vomitus following the onset of paralytic ileus and gastric dilatation.

In the Gynaecological Department two deaths occurred:

1. A faecal fistula that occurred following a total hysterectomy and double salpingo-oophorectomy was subjected to many operations for cure—death occurred from peritonitis following one such operation and a carcinoma of the pelvic colon with obstruction was demonstrated at post-mortem.

2. A right salpingo-oophorectomy was performed for right-sided abdominal pain. Some ten days later, following much intermittent vomiting, the patient collapsed and died. Post-mortem revealed Crohn's disease of terminal ileum with obstruction.

Caecostomy as a cause of death

Caecostomy was responsible for six deaths in the ten cases in which it was carried out.

In three of these cases there was failure to decompress the large bowel and in three peritonitis from leakage at the site of caecostomy.

In the remaining 45 cases of colonic obstruction 43 colostomies were performed and 8 deaths occurred — a mortality of 18 per cent.

Although caecostomy when properly performed is adequate for some situations it would appear that colostomy is a much safer procedure.

MISCONCEPTIONS RE MORTALITY

(1) Age: It is usually stated that the very young and the very old withstand intestinal obstruction badly.

In the very young intussusception was treated with 12 per cent. mortality—likewise the average age of strangulated hernia cases dying was identical with those recovering 66 and 67—both being over 60.

(2) The general condition of the patient did not seem to affect the outcome to an extent expected by the usual teaching. Patients with prior coronary occlusion, gross hypertension, chronic bronchitis, cirrhosis, diabetes and cardiac failure survived the added burden

of obstruction in greater numbers than those who died, when comparable obstructions are compared in both groups.

(3) Delayed admission: Apart from three cases who were moribund and did not survive 4-6 hours, survival of the remaining cases seemed to depend more on the presence of a potentially strangulating process than on the length of time since the onset of the episode that demanded admission, e.g., a patient who died soon after admission had a Richter's hernia of one day's history.

INTESTINAL SUCTION

In this series of cases too ready a reliance on intestinal decompression by suction led to three fatalities. It is our firm opinion that intestinal decompression should be maintained only so long as improvement is occurring and that it can only be continued as the sole means of therapy when it is known by a previous laparotomy that adhesive bowel obstruction is the likely diagnosis; even then a careful watch is necessary to be certain that strangulation does not occur under one's very eyes.

ANTIBIOTICS

Antibiotics as a cause of lowering the mortality in the general run of cases of intestinal obstruction were not at all impressive. In the cases of peritonitis where it was possible to remove the source of continuing peritoneal infection it was our impression that intravenous Oxytetracycline or Tetracycline of the order of 1.0 gm. per day, had a good effect, sometimes a dramatic one. Otherwise there was no clear-cut evidence to suggest an impressive change. Certainly in the case of strangulation they seemed to cause no improvement in the prognosis.

CONCLUSIONS

1. Aspiration decompression should be used purely as a preliminary to laparotomy except in cases where it is surmised that obstruction is due to intestinal adhesions proven by previous laparotomy or laparotomies.

2. Aspiration decompression (plus parenteral fluid and electrolytes) should be continued until maximum improvement in the patient's condition has been obtained. This should be judged on:
   (a) General sense of well being, hydration and urinary output.
   (b) Pulse rate and blood pressure.
   (c) Localized, distended and tender loops of bowel.
   (d) Bowel sounds.
   (e) X-ray films.
   (f) Amount and colour of aspirate.

3. Laparotomy is indicated if improvement does not occur within a few hours or ceases to progress. In any case within 24 hours a general review of the situation is necessary and if the slightest doubt of the efficacy of the treatment exists a laparotomy should be carried out about this period.

4. We are strongly of the opinion that intragastric decompression is adequate in the vast majority of cases. In our estimation intestinal decompression should be reserved for cases of adhesive obstruction who show no sign of settling after some days to a week. Should laparotomy then be necessary the passage of a Miller Abbott tube under vision into the jejunum is more likely to promote recovery than intragastric suction alone.

5. Enterostomy (jejunostomy and ileostomy) is a highly fatal procedure in our experience. We would prefer to employ an intestinal tube and have found that even whilst upper bowel paralysis persists lower bowel tone returns—it is then possible to feed the patient via the intestinal tube (even though aspiration still be proceeding from the upper alimentary tract via a second intragastric tube).

6. It is apparent that the mortality of strangulation is still inordinately high—certainly in this series. It is therefore necessary to operate early on all cases which are liable to involve strangulation of bowel at some future date. That this causes a great improvement in overall figures can be seen from Moses' 125 cases quoted above.

The general training of all medical practitioners and especially that of surgeons should be improved so that not only will intestinal obstruction be thought of and therefore diagnosed more rapidly, but also

its therapy carried out rationally and purposefully.

It is only by constant awareness and desire to improve one's result that progress can come in the strangulated cases. The axiom that any lesion liable to cause bowel strangulation at however remote a date should be subjected to surgical treatment will help to lower the strangulation rate. There will always, however, be the unpredictable cases of strangulation—as in superior mesenteric artery thrombosis. In these cases we have little more to offer our patients than had Charpentier in 1872.

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GROSS DAMAGE TO THE PORTAL VEIN AND HEPATIC ARTERY DURING CHOLECYSTECTOMY

By Norman R. Wyndham

Sydney

WHEN the portal vein or hepatic artery is tied in experimental animals, death usually follows quickly from gross liver necrosis. Life can be prolonged by the administration of antibiotics but in animals such as the dog, death is apparently inevitable. Child *et alii* (1952) have shown that these results cannot be applied to man since the arrangement of the blood vessels is not the same in both. Using the macaque monkey for the experiment they showed that ligation of the portal vein was not incompatible with life. A transient rise in portal venous pressure was followed in about two weeks by a return almost to normal. The mechanism of the rapid readjustment is not clear. The same procedure was then adopted in the human subjects suffering from growths of the pancreas, with similar results.

Ligation of the hepatic artery has been performed on numerous occasions in cases of portal hypertension with few immediate deaths and a lowering of portal venous pressure.

Ginsburg and Grayson (1952), have recorded their observations on the inter-relations of the portal and systemic circulations of the liver. It would appear that the two circulations do indeed intercommunicate, the anastomoses being guarded by wedge-shaped valves. Flow through the portal vein is twice that in the hepatic artery. Clamping the portal vein caused a fall of 60-80 per cent. in the total flow through the liver while clamping of the hepatic artery was followed by a reduction of 10-40 per cent., this being quickly restored to normal.

This paper records the case of a healthy woman whose portal vein was divided completely and that of a woman without portal hypertension whose hepatic artery was ligated.

Complete Division of Portal Vein with Delayed Repair

M.L. was a married woman of 34 years, admitted to a suburban public hospital on 23rd June, 1953. She gave a history of chronic cholecystitis with stones for a number of years. There was nothing unusual either in her history or physical condition.

Cholecystectomy was performed on the day after admission. The surgeon reported no obvious anatomical abnormality but profuse bleeding occurred which was difficult to locate. After the operation a very large amount of blood came from the drainage tube and this increased in amount. By the next day it was obvious that intraperitoneal bleeding had also occurred.

For six days after operation her condition became gradually worse although the pulse rate and temperature did not vary significantly. On the seventh day her deterioration became more obvious. The complexion was sallow with some icterus. Bile and albumen appeared in the urine. The pulse quickened and the temperature rose and became swinging. The abdomen became grossly distended, partly from dilated bowel and partly from intraperitoneal fluid, which was thought to be blood.

She was seen by the writer on the ninth day after operation when it did not seem likely that operative intervention was indicated. Bleeding had apparently ceased. The abdominal distension was due to ileus as well as haemoperitoneum. Two days later operation was undertaken as a desperate measure because of a sudden deterioration in her condition. Under open ether anaesthesia the abdominal wound was reopened. There had obviously been a massive haemorrhage. A large quantity of old blood was evacuated, about half consisting of clots. Most of these lay in the pouch of Morison. The liver was enlarged but not grossly so and its external appearance presented no unusual feature.

The common bile duct and hepatic artery were intact. The portal vein had been completely divided. The hepatic end had been ligated but the distal end was occluded by a clot. This was friable and was removed by means of a probe and sucker to a distance of 2½ inches (6.25 cms). Only a small trickle of blood resulted. The hepatic end of the vein was cleared in a similar manner and the continuity restored with fine silk sutures.

Forty-eight hours after this operation the patient's condition appeared to be slightly better. This improvement was maintained but it was not for over a week that complete recovery appeared possible. This was delayed by two large abscesses, one in the wound and one in the buttock. The organism responsible was a coagulase-positive *Staphylococcus aureus* sensitive to streptomycin and chloromycetin but resistant to penicillin. It had been impossible to grow any organisms from the blood extravasated in the abdomen.

The patient gradually regained normal health and, two years after the operation, was well and free of all symptoms referable to the biliary tract. There were no signs of impairment of the portal circulation, no evidence of oesophageal varices and no laboratory evidence of impaired liver function. She had an incisional hernia in her original cholecystectomy scar and had had two attacks of acute upper abdominal pain with distension. We advised laparotomy, hoping that this decision was unrelated to our interest in the state of the portal vein. She was admitted to Royal Prince Alfred Hospital and laparotomy was performed on 7th July, 1955. The pressure in the mesenteric veins was normal. A portal venogram failed to demonstrate the portal vein itself but the superior mesenteric vein was clearly shown to be free of obstruction. The spleen was normal in size though buried in the dense adhesions which were so abundant throughout the upper abdomen. The liver appeared normal. A liver biopsy was performed. This was later shown to be normal although more than the usual number of lymphocytes were present around the biliary radicles. The portal vein was demonstrated and shown to be patent and normal in size though scarred on the surface. There was no stricture. The incisional hernia was repaired as the abdomen was closed. Recovery was uneventful.

it would seem that some parenchymal liver damage or loss of function occurred post-operatively (Fig. I). This is supported by the appearance of the liver at the second operation. At the same time no obvious obstruction to the common bile duct was apparent, although haematoma around it may have pressed upon the duct. The laboratory findings could be explained by rapid absorption of blood pigments from the haemoperitoneum. This has been seen in other cases of gross intraperitoneal haemorrhage.

Recent work already discussed in this paper has shown that obliteration of the portal vein by ligature is not inconsistent with life. No patient has been followed up previously for two years after such a procedure.

LIGATION OF THE COMMON HEPATIC ARTERY

This operation has been performed frequently in cases of portal hypertension as a

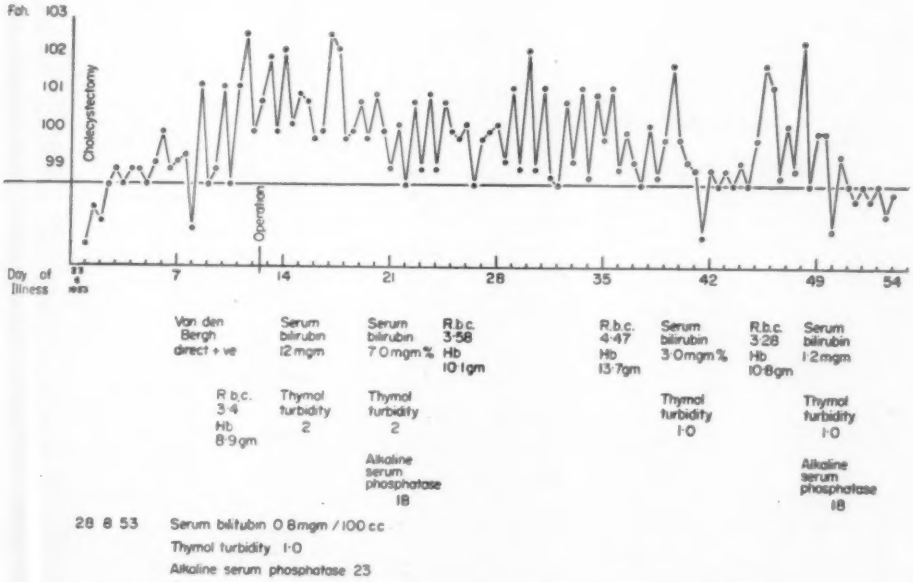

FIG. I. Temperature chart and liver function tests at intervals after first operation.

COMMENT

In a small hospital with minimal laboratory facilities it was impossible to carry out full investigations. Without discussing in detail the manner of presentation of the results of the liver function tests or their significance, deliberate procedure. In the case recorded here the only liver disease present was due to chronic biliary obstruction.

Case History

M. J. was a married woman of 49 years. She was seen by me first on 20th Oct., 1953, when the

relevant history was of a cholecystectomy seventeen months previously for gall-stones. Symptoms returned after three months. Six weeks before seeing me she had had a second operation and had been discharged from hospital only two weeks before. Her symptoms of pain, jaundice and fever had already returned. After neither operation was drainage from the wound excessive.

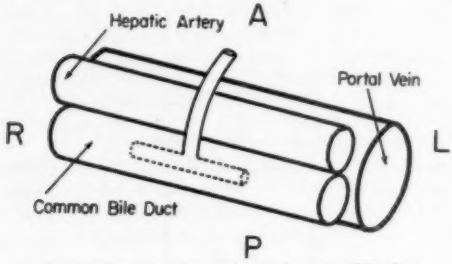

FIG. II. Diagram to show relation of common bile duct and vessels. A — anterior; P — posterior; R and L — right and left.

At operation on 22nd October, 1953, a stricture of the common hepatic duct was found. This was excised and repaired over a "T" tube, the long limb of which was introduced through an opening below the stricture. A somewhat abnormal relation of the structures around the common bile duct was seen, the portal vein lying anterior and the common hepatic artery being anterior to the common bile duct (Fig. II). The immediate post-operative course was normal.

On the twentieth post-operative day she complained of epigastric pain and vomited a few ounces of blood-stained fluid. She was cold and clammy. The systolic blood pressure was 90 mm. Hg. A diagnosis of intra-abdominal bleeding was made, the cause being unknown. Her condition improved after a transfusion of two pints of blood but three days later bright bleeding occurred through the "T" tube. Again she was shocked and collapsed. A second transfusion of two pints of blood was given. Rapid recovery was again followed by fresh bleeding and collapse five days later, the bleeding again coming from the "T" tube. Operation was advised and performed on 21st Nov., 1953. The bleeding was coming from a large hole in the side of the hepatic artery which had been eroded by the "T" tube. Complete obliteration of the artery with silk sutures was required.

After operation the jaundice, which had been slight up to this time, became marked. The serum bilirubin level rose from 1.8 mgms. to 8 mgms. per 100 cc. She became drowsy and remained critically ill for ten days. The jaundice had gone completely eight days after the operation. Her liver function tests did not become normal (Fig. III) for four weeks but at no time did these show any great degree of parenchymal damage. Choledochogram performed on 15th December, 1953, revealed no evidence of stricture or of obstruction. This was repeated on 4th Feb., 1954, and was normal. The "T" tube was then removed.

She remained well for six months after this when evidence of biliary obstruction and "intermittent hepatic fever" again appeared. The duct was explored again on 2nd Sept., 1954, when it was found that the stricture had recurred. This was excised again and so far (18 months) the patient has remained perfectly well. At the last operation the obliterated portion of the hepatic artery was identified. In the region of the *porta hepatis* there was a network of small blood vessels so that exploration in this area would have been impossible. Fortunately this was not necessary. As it was there were numerous small blood vessels all over the common bile duct. Apart from bile staining the liver did not appear particularly abnormal and a biopsy confirmed this.

	Thymol Turbidity	Alkaline Serum Phosphortase	Bilirubin	
				2nd Operation, 22nd Oct., 53
11th Nov., 53	— ve	13.2	1.8	
				Reoperation for Haematemesis 21st Nov.,53
26th Nov., 53	+ +	12.9	7.3	
10th Dec., 53	— ve	11.7	1.0	
22nd Mar., 54	1 unit		1.0	
2nd Jun., 54	+ +	37.8	0.4	
2nd Jul., 54				Reoperation
21st Aug., 54	+ Zinc Sulph. 6.5	63.3	6.3	

FIG. III. Table to show function tests performed after operative procedures.

She has had no further trouble so far. There has been no recurrence of jaundice and her liver function tests, done nine months after her second operation for stricture, were normal.

COMMENT

There are several features in this case to which attention is drawn. The dispositions of the major structures in the right free border of the lesser omentum necessitated great care in the dissection of the common bile duct. The damage to the hepatic artery from contact with the long limb of the "T" tube was not at first apparent.

The results of ligation of the hepatic artery were awaited with some trepidation. The semi-comatose, intensely jaundiced appearance of the patient was thought to be due to acute liver failure, despite the lack of support by the laboratory findings. Fortunately, recovery was much more rapid than expected. In what way compensation has occurred for the loss of blood supply from the hepatic artery is not clear. Apparently numerous small vessels had penetrated the liver substance from the surrounding connective tissue. New systemic vessels were obvious at the last operation but these could have played little part in the immediate recovery phase. There has been no demonstrable damage to the liver due to the ligation of the hepatic artery in this case.

SUMMARY

Ligation of the portal vein and the hepatic artery associated with cholecystectomy has been discussed in the literature.

A case of each complication is described here.

ACKNOWLEDGEMENT

I am grateful to Dr. C. R. B. Blackburn, Clinical Research Unit, Royal Prince Alfred Hospital, for his advice and assistance in these cases.

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PROCTITIS AND PROCTOCOLITIS

By E. S. R. Hughes

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THERE is a number of inflammatory lesions affecting the rectum and colon which appear to be closely related. However, their separation into clinically recognizable groups is helpful, both from the point of view of prognosis and treatment. The purpose of this review is to indicate the classification used by the writer in a personal series of eighty-four cases.

Proctitis—thirty-five cases

With this lesion the patient complains of bleeding and frequent motions. Questioning often reveals that the patient has one normal solid motion each day, but, in addition, there are several other bowel actions during the day, but on each occasion only a small amount of blood, mucus, and possibly some purulent fluid is passed.

On sigmoidoscopy one sees a diffuse, inflammatory process, involvng the rectal mucosa, and extending to eight centimetres, fifteen centimetres, or on rare occasions to as high as twenty centimetres, but above the upper level one can visualize normal mucosa (Fig. I). Mucosal ulcers may be visible, but they are rare in proctitis.

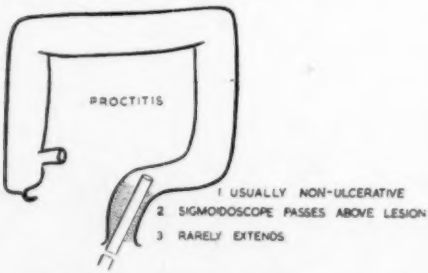


FIG. I. Drawing showing the distribution of the lesion in proctitis. Compare Fig. II.

As a rule, the course of the disease is benign. In most instances it persists for a while and then appears to subside.

In one such case, Miss G., aged 69, the proctitis of 11 months' duration extended to 10 centimetres, and above this level, the mucosa was normal. The symptoms became so distressing that she was admitted to hospital for two weeks, but failed to improve after a course of cortisone and antibiotics. Six months later her symptoms persisted unchanged and the bowel retained an angry appearance to ten centimetres. Twelve months later again, and two and a half years after the initial onset of the illness, she was reviewed and was found to have made a complete recovery, both symptomatically and on sigmoidoscopy.

In one case of the writer's series, the lesion developed into a mild proctocolitis (ulcerative colitis).

Mr. E., aged 27, was seen originally with a proctitis, which extended to 11 centimetres; his symptoms became worse, and eight months after the first examination, sigmoidoscopy showed that the lesion extended to 18 centimetres, but beyond this, the instrument could not be passed. A barium clysma at this stage showed that the sigmoid colon, at least, was involved.

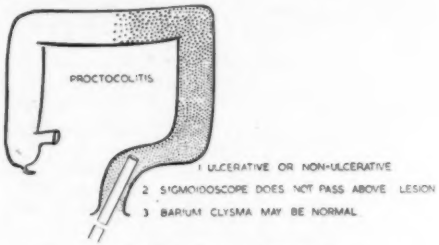


FIG. II. Drawing showing distribution of the lesion in proctocolitis. Compare Fig. I.

Proctocolitis (ulcerative colitis) — forty-two cases

This term has been used to designate those inflammatory lesions of the rectum and colon, the upper level of which cannot be reached on sigmoidoscopic examination (Fig. II). Proctocolitis may be ulcerative or non-ulcerative (Figs. III and IV), but one seems to be a phase of the other (Dukes, 1954).

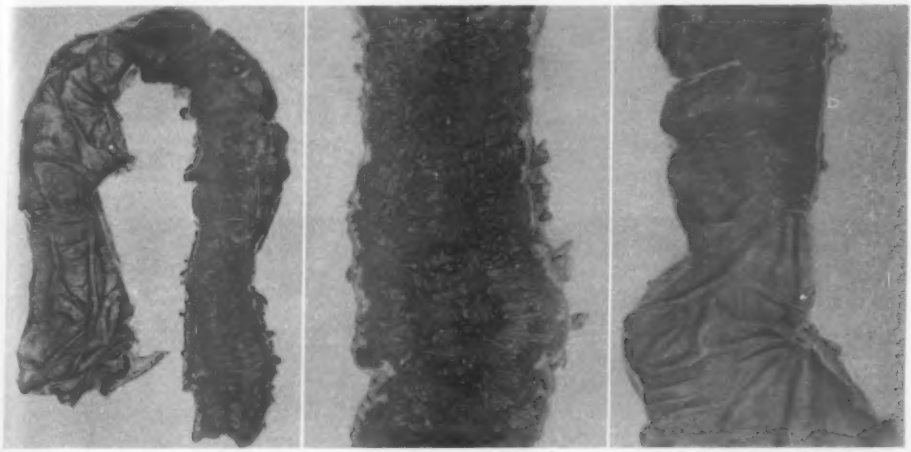
In 7 of these cases a barium clysma was normal and this led the writer to assume that the upper level of the lesion was only just beyond the end of the sigmoidoscope. Accordingly the lesion was regarded as a proctosigmoiditis and comparable with proctitis in the relatively benign course which was pursued. However, this did not prove to be the case in four of these 7 patients.

For example, Mr. D., aged 74, presented with a six months' history of "proctitis." The lesion extended to 18 centimetres beyond which the instrument could not be passed; the barium clysma was normal and the diagnosis was regarded as proctitis (or proctosigmoiditis) and the benign course was forecast. His symptoms became worse and he grew weaker; he finally died two months after the original investigations, eight months after the onset of the symptoms, with a diffuse ulcerative colitis.

A barium clysma examination shows involvement of the colon up to the descending colon, to the transverse colon or the disease may have affected the whole of the large bowel (Figs. III and IV).

Miscellaneous—seven cases

In one case in this series, the patient, Mrs. M., aged 40, had suffered from diarrhoea for fourteen years. A year before investigation she had had a



(a) (b) (c)

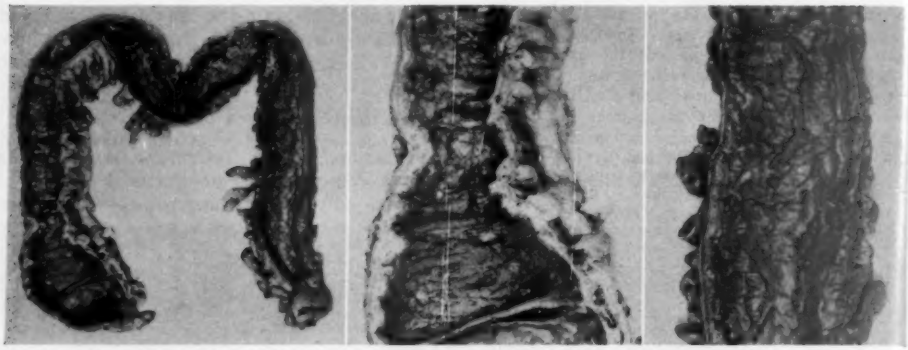
FIG. III. Mrs. R., aged 40: Acute ulcerative colitis with severe toxaemia. Emergency ileostomy and colectomy performed (a). Gross degree of ulceration present in the left half of the colon (b). In the right half of the colon, the bowel was macroscopically normal; at the transition zone a segment of the mucosa was acutely inflamed, but without visible ulceration (c).

A female, Miss L., aged 62, was referred with diarrhoea and bleeding of one month's duration. Sigmoidoscopy to 18 centimetres revealed proctitis and, although the upper level of the lesion was not reached, the barium clysma was normal. Her symptoms progressed rapidly and she died a month later with extensive ulceration of the large bowel from rectum to caecum, associated with numerous perforations into the peritoneal cavity (Fig. V.). In two other cases, the course was progressive but at a slower rate, so enabling successful excision of the colon and rectum.

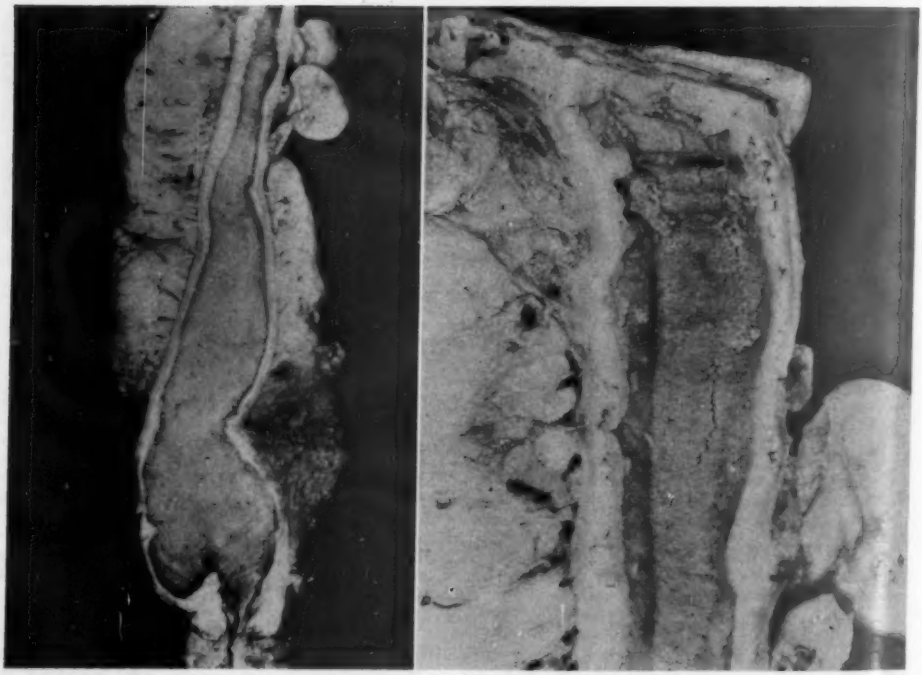
In the typical case of proctocolitis there is a diffuse inflammatory lesion of the rectum and sigmoid colon. Ulcers may be difficult to define because they are filled with slough or bloody fluid but, on the other hand, they may be easily seen as irregular, whitish islands on the surface of deeply injected mucosa; ulcers are much more common in proctocolitis than in proctitis. The lumen of the bowel contains a variable amount of faecal fluid mixed with blood, mucus and pus.

haemorrhoid operation which had left a stricture within the anal canal. Sigmoidoscopy showed diffuse proctitis, and the upper level of inflammation was not reached at twenty centimetres from the anus. Barium clysma examination revealed involvement of the whole of the colon to the caecum. At operation thickening of the whole of the colon was disclosed, but the ileum appeared normal. After removing the colon, the mucosa was found to be diffusely affected, although the only ulceration was seen in the caecum. The mucosa of the ileum was thickened, red and friable (Fig. VI).

Presumably, this type of case belongs to that group described by Brooke as ileocolitis (Brooke and Cooke, 1951), and regarded by him as a disease originating from a small bowel defect with secondary effects upon the colon, simulating ulcerative colitis. However, in this case the convalescence after a one-stage ileostomy and proctocolectomy was uneventful, which is contrary to the experience of Brooke and Cooke (1951) and Morrow (1955).

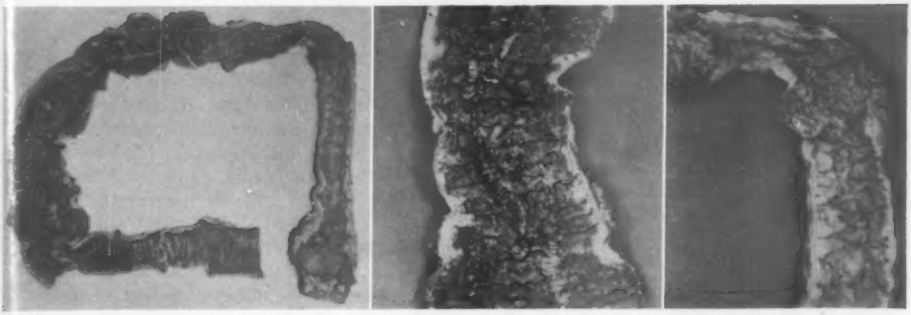


(a) (b) (c)



(d) (e)

FIG. IV. Mrs. W., aged 40: Acute ulcerative colitis with severe toxaemia. Emergency ileostomy and colectomy performed (a). Gross ulceration present from the sigmoid colon to the caecum (b and c). Four months later the rectum was removed (d and e); there was no ulceration, but the mucosa was thickened, oedematous and friable.



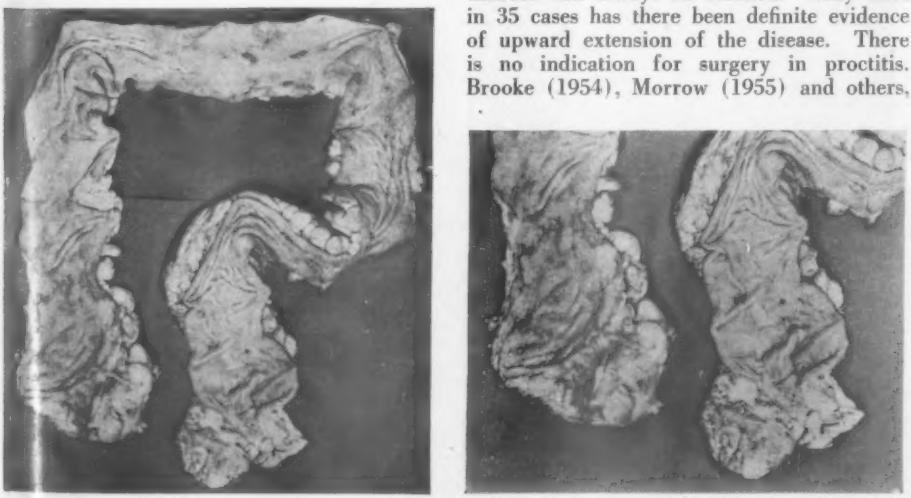
(a) (b) (c)

FIG. V. Mrs. L., aged 62: Acute overwhelming ulcerative colitis responsible for fatal toxaemia (a). One month prior to operation, sigmoidoscopy showed a diffuse non-ulcerative proctitis, and a barium clysma was normal. The right (b) and left halves (c) of the colon are involved.

In six cases, the lesions corresponded with those described as segmental colitis (Neuman and Dockerty, 1954). In one, the bowel was involved from the caecum to the sigmoid; in a second the right half of the colon was affected, and in four the disease was confined to the caecum, and ascending colon (Fig. VII).

DISCUSSION

Milligan (1933) described the distinguishing features of granular proctitis and ulcerative colitis. Milligan stated quite emphatically that the rectum alone might be involved in this inflammatory change (proctitis), may remain so for years without upward spread, and that patients so afflicted can be given the confident assurance that their bowel nearly always ultimately returns to the normal condition. In the writer's experience it is not possible to distinguish satisfactorily a "granular" proctitis as a specific disease; the appearance of the mucosa in proctitis is the same as in proctocolitis, but in the former ulceration is uncommon and the upper limit of the diseased mucosa can always be reached. Only once in 35 cases has there been definite evidence of upward extension of the disease. There is no indication for surgery in proctitis. Brooke (1954), Morrow (1955) and others,



(a) (b)

FIG. VI. Mrs. M., aged 40: Ulcerative colitis for which primary proctocolectomy was performed (a). The ileum was involved and ulceration was present in the caecum, but not in the rectum (b).

refer to "procto-sigmoiditis," but the writer recommends that the use of this term be discontinued. If the upper level of the inflamed mucosa cannot be reached with the sigmoidoscope, the lesion should be regarded as proctocolitis or ulcerative colitis. A normal barium clysma does not mean that the colon is not involved, nor can the extent of the lesion be determined by this investigation. Furthermore, the progressive course pursued by these cases originally called procto-sigmoiditis by the writer, links them with the proctocolitis or ulcerative colitis group. If the patient has a proctitis, surgery is not required, despite severe symptoms; if, however, the upper limit cannot be reached with the sigmoidoscopy, a normal barium clysma should not deter the surgeon from treating the disease by radical surgery if the indications should arise.

FIG. VII. Mr. M., aged 37: Segmental colitis. Right hemicolectomy performed for mass in the caecum; it proved to be inflammatory in nature and confined to the caecum and the proximal half of the ascending colon.

The colon and rectum removed for ulcerative colitis may show innumerable ulcers of variable size with ragged walls and whitish floors (Figs. III, IV and V); but, in many cases, the mucosa has a velvety, oedematous, thickened, granular appearance (Figs. III and IV) and, although very friable and often exhibiting polypoidal elevations, the mucosa is free of macroscopic ulceration. One appearance seems to be a phase of the other (Cuthbert Dukes, 1954) and hence proctocolitis might be described as ulcerative or non-ulcerative, although the presence or absence of ulcerations will not affect the management.

Brooke (1954) and Morrow (1955) have warned of the disaster which might follow construction of an ileostomy in the group classified by them as "ileo-colitis." Brooke (1954) has described this lesion as primarily small bowel in origin, with resulting steatorrhoea and causing a secondary involvement of the colon, which might be indistinguishable from ulcerative colitis. There has been one case in the writer's series which seems to correspond to this group, but progress after one-stage ileostomy and procto-colectomy was uneventful. Other cases correctly belonging to this group might have been overlooked or confused with proctocolitis. Other inflammatory lesions affect the colon, but their accurate classification is still difficult and as they are relatively uncommon, they might, for the time being, be grouped together.

SUMMARY

1. Inflammatory lesions of the colon and rectum have been variously classified.

2. It is suggested that the simplest classification is as follows:

   (i) *Proctitis:* A lesion, the upper level of which can be reached with the sigmoidoscope.

   (ii) *Proctocolitis:* A lesion, the upper level of which cannot be reached with the sigmoidoscope, and which may be associated with a normal barium clysma, or one with evidence of colitis.

   (iii) *Miscellaneous:* This group includes ileo-colitis and other not well-defined lesions, such as segmental colitis.

3. Proctitis nearly always pursues a benign course, and only rarely continues proximally to involve the colon. When the upper level of the inflamed mucosa can be reached, the patient can be reassured; there is no indication for surgery in this disease.

4. Proctocolitis, whether ulcerative or non-ulcerative, can be regarded as synonymous with the more widely used term, ulcerative colitis. A normal barium clysma should not bring undue confidence because, in the early stages of the disease, there may not be detectable changes visible in the X-ray examination.

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MASSIVE HAEMOBILIA FROM AN HYDATID CYST OF THE LIVER

By Eric Goulston

Sydney

HAEMORRHAGE into the biliary tract has been observed in rare cases, usually following trauma to the liver. Wright, Prigot and Hill (1947) mention haematemesis as a symptom and Sandblom (1948) describes the occurrence of melaena, as well, in nine patients who had also suffered trauma to the liver region resulting in haemorrhage into the biliary tract. This condition is named "haemobilia" (Sandblom, 1948; Epstein, 1952), and may cause haematemesis, melaena, biliary colic and biliary obstruction. It may not be uncommon even in subcapsular liver injuries. A case of haemobilia associated with haemorrhagic cholecystitis following a ruptured liver, with recovery, was reported by Epstein (1952).

Haemobilia may be of intra- or extra-hepatic origin. Intra-hepatic sources have been described as following trauma, yellow atrophy, haemangioma and aneurysmal rupture of the hepatic artery, whilst extra-hepatic sources such as calculi in the gall-bladder or common duct, post-operative dilation of the common duct, carcinoma of the ampulla of Vater, and erosions and aneurysm of the hepatic vessels, have been recorded.

The thin-walled vessels of the liver parenchyma have only slight power of contraction and a large central cavity or a rupture of the liver which may or may not have been packed, may lead to prolonged haemorrhage into the biliary passages and thence to the bowel. There may be varying degrees of associated jaundice.

The following case presented with massive and fatal bleeding from the bowel extending over a period of five months. The cause was not established until autopsy when a large central hydatid cyst cavity containing necrotic material, blood and bile was found in the right lobe of the liver; it was from this source that the bleeding had occurred.

Case Report

A male patient, aged 61 years, was admitted to hospital on account of severe attacks of upper abdominal pain, vomiting and loss of weight for the previous two months. He had complained also of rectal bleeding for the previous month. On examination he presented as a large, pale well-nourished man of the stated age. There was tenderness in the right upper part of the abdomen where an enlarged tender liver could be readily palpated. The temperature was 100°F, Hb percentage was 4 grams per cent., the serum bilirubin and liver function tests being normal and the Casoni reaction negative.

A barium meal examination revealed no abnormality and, except for extreme anaemia, as did the marrow puncture and blood examinations.

After blood transfusions, a laparotomy was performed two weeks after admission and an oedematous, acutely inflamed, large gall-bladder containing much debris was removed. The liver felt soft and "mushy" and a biopsy was taken. The specimen was reported as showing necrotic and granulation tissue presumably from an attempt to wall off an area of necrosis.

Subsequent progress was marked by varying episodes of massive bleeding *per rectum*, sometimes dark and sometimes bright red and necessitating many transfusions. A barium enema revealed well-developed diverticulosis throughout the colon. Sigmoidoscopy, oesophagoscopy and gastroscopy gave negative findings and, as the bleeding continued, laparotomy was performed. Apart from the diverticulosis of the colon and the enlarged liver, no abnormality was found so a transverse colostomy was performed in the belief that the bleeding was from the diverticula in the colon. Despite early improvement, massive bleeding occurred from the colostomy and shortly afterward haematemesis began and developed to an alarming degree. After resuscitation a further laparotomy was performed and in the belief that an undisclosed ulcer may have been present in the second part of the duodenum, which was difficult to palpate, gastro-enterostomy and pyloric occlusion were performed. A period of four and a half months had thus passed and over 30 litres of blood had been transfused. The patient then developed jaundice; his liver function tests showed deterioration and after further haematemeses and melaena he died.

Autopsy revealed on opening the duodenum an extensive thin folded sheet of fibrinous material which was completely obstructing the opening of the ampulla of Vater and appeared to be a cast of the biliary tree. However, on microscopic examination, the membrane was found to be hydatid

laminated membrane which had been extruded from a cyst in the liver. The liver was large and soft and contained in the centre of the right lobe a large cyst, measuring five inches in diameter, which contained a large amount of clotted blood and a solid core of fibrinous material. The wall of the cyst was ragged and tough and the cyst appeared to be in communication with several bile ducts. The biliary system appeared dilated, the contents containing blood, bile and pus. Apart from diverticula in the large bowel there was nothing else relevant.

COMMENT

An hydatid cyst of the liver often, as it enlarges, comes into contact with intra-hepatic blood vessels; as a rule these are venous channels and are occluded by pressure and quiet thrombosis. Cases, however, have been recorded in which intravenous leakage of hydatid fluid and scolices into the hepatic vein have occurred with the development of either secondary metastatic hydatid cysts in the lungs or with anaphylactic symptoms, these being sometimes fatal. As well, severe immediate or delayed post-operative haemorrhage after the evacuation and drainage of hydatid cysts has been recorded—the result of the sudden removal of intracystic support from adjacent thin-walled vessels. These, as a rule, can be controlled by packing the cyst cavity although it is quite possible that fatal unrecorded cases have occurred. In the case here recorded there must have been first a leakage of the cystic contents into the intra-hepatic biliary passages — a not uncommon occurrence in hepatic cysts, associated with the first attack of pain, followed by secondary haemorrhage into the cavity.

This led to the passage of blood mixed with bile and some debris down the common duct. I do not remember having encountered or having heard of a similar case so that this pathological coincidence must be very rare; it is another example of the protean manifestations of hydatid disease of the liver.

SUMMARY

A case of fatal massive bowel haemorrhage is reported occurring from an unrecognized necrotic hydatid cyst of the liver.

ACKNOWLEDGEMENTS

These are due to Professor Sir Harold Dew for his comment, to Dr. Colin Graham for the autopsy report, and to the Resident Staff of the Royal North Shore Hospital for their care of the patient.

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CO-EXISTENT SEMINOMA AND TERATOMA OF THE TESTIS

By Anthony F. Hunter

Green Lane Hospital, Auckland

THIRTY-SIX cases of this uncommon co-existence of a seminoma and a teratoma in one testis have so far been recorded. The last case reported was by Cardell and Hopewell (1954) and their report includes a review of the preceding thirty-five cases recorded. In view of their rarity I submit this case report.

Case Report

E.C.W., aged 35, was admitted to Green Lane Hospital, Auckland, on 1st March, 1955. He gave a history that he had noticed a painless swelling of his right scrotum for just over two months. He had first noticed it on 23rd December, 1954. Three weeks before admission the right scrotum was aspirated by his private practitioner and a blood-stained fluid obtained. There was no history of injury.

On examination, it was noted that he had a moderate sized, right hydrocele and the right testicle was large, firm and not tender on palpation. We therefore made a diagnosis of neoplasm of the right testicle. There was no clinical or X-ray evidence of any secondary deposit. A male frog test-qualitative was negative, and quantitative 1 : 10 was negative.

On 3rd March, 1955, I performed a right orchidectomy. Through a transverse incision in the right groin the spermatic cord was divided at the internal ring and the spermatic cord, testicle, and its coverings were removed *in toto*. Following operation he received a course of deep X-ray therapy, a dose of 2,000 r being given to the aortico-caval area and the right groin.

At the time of writing, six months after operation, he is alive and well and shows no evidence of metastases. An X-ray film of the chest made on 15th August, 1955, showed no abnormal shadow.

Macroscopic pathology

The specimen (Fig. I) showed that most of the testis had been replaced by tumour, there being only a small amount of testicular tissue compressed at the lower pole of the organ. Two distinct tumours were present. The larger of these measured 3 x 6 cm. and occupied the upper pole of the testis. This tumour proved later to be the teratomatous part and showed an area of haemorrhage about 1 cm. across and multiple small cystic spaces.

In the lower pole there was a white homogeneous tumour, 1.5 cm. in diameter, which proved later to be seminomatous in structure, and macroscopically it appeared that this tumour was distinct from the other.

FIG. I. Vertical section of the testis. The upper mass is a teratoma (Figs. II and III) and the lower seminoma (Fig. IV).

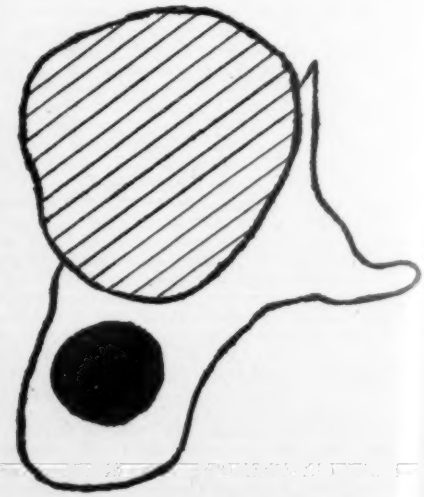

FIG. Ia. Key diagram to Fig. I showing teratoma hatched and seminoma black.

FIG. II. Low power photograph showing band of fibrous connective tissue separating teratoma from seminoma.

Microscopic pathology

Several sections from the zone between the two tumours showed that these were separated completely by a band of fibrous connective tissue (Fig. II). Sections from the teratomatous area (Fig. III) showed numerous cysts with lining epithelium varying from flattened to tall columnar. These were set in a loose, fibrous, connective tissue stroma. A few areas of mesenchymal tissue containing stellate cells were present. There was haemorrhage into one area and about this were syncytial masses of large cells having hyperchromatic nuclei. This area had the appearance of a chorion-epithelioma. Mitotic figures were seen.

FIG. III. Photomicrograph of a section of the teratoma.

Sections from the seminomatous area (Fig. IV) showed a well-defined uniformity in histological structure. There were clumps of large, round cells having hyperchromatic nuclei. The nuclei were surrounded by a rim of clear cytoplasm. Mitotic figures occurred. The stromal tissue consisted of strands of fibrous connective tissue containing a small number of lymphocytes. Sections of the spermatic cord did not show any tumour.

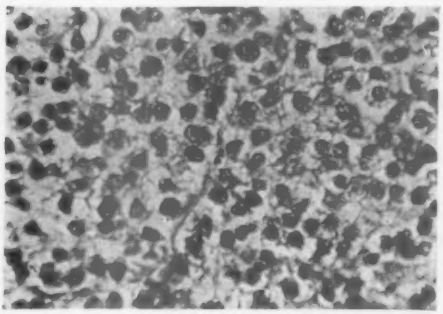

FIG IV. Photomicrograph of a section of the seminoma.

DISCUSSION

The macroscopic and microscopic findings warrant the conclusion that in this case the teratoma and the seminoma are two distinct and separate tumours within the same testis.

Scully and Parham (1948) state that classification of testicular tumours have been largely based on two theories of pathogenesis:

1. Ewing's theory that all the common testicular tumours are forms of teratoma and the histologically uniform neoplasms represent one-sided developments of teratoma.

2. Chevassu, on the other hand, concluded that the histologically uniform tumour, which he named *seminome*, because of its supposed origin from the seminiferous epithelium, is a distinct tumour not arising from teratoma.

Willis (1948), in his review of fifteen cases, states that none of the cases showed any evidence of histogenetic relationship between the teratomatous and the seminomatous tissues. There is certainly no evidence of histological relationship between the two tumours in this case and nothing to suggest that Ewing's theory is correct.

SUMMARY

The clinical and pathological features are recorded of a further case in which a teratoma and seminoma existed in the same testicle.

ACKNOWLEDGEMENTS

I wish to thank Mr. J. Dreadon for permission to publish this case, and I am also grateful to Dr. Flora Smith and Dr. S. E. Williams for the histological data, and Mr. A. W. Burge of the Photographic Unit, Auckland Hospital.

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INTESTINAL OBSTRUCTION DUE TO A PHYTOBEZOAR IN A FEMALE AGED 79 YEARS

By Ivan S. Epstein

Alfred Hospital

A BEZOAR is a mass of foreign material found in the stomach and intestines of both men and animals. The derivation of the word is obscure but is believed to be from the Arabian "badzehr" or the Persian "padzahr," which mean antidote; and since ancient times they have been credited with magical beneficial properties, being worn as charms or taken internally for the prevention or treatment of various afflictions.

Cases have been recorded in the medical literature since 1779 when Baudamant reported the first case of hairball. In 1938 De Bakey and Ochsner analysed 311 cases and a review of the subject by Tondreau and Kirklin in 1950 indicated that the total number of recorded cases at that time was approximately 400.

Classification

Bezoars may be divided into four types, according to their composition:—

(1) *Trichobezoars* — composed of swallowed hair. Cotton and wool thread, string and bristles have been reported as making up part of the hairball.

(2) *Phytobezoars* — composed of the stems, fibres, leaves, roots or seeds of a large variety of fruit and vegetable materials moulded together to form compact masses.

(3) *Trichophytobezoars* — a combination of (1) and (2).

(4) *Concretions* — formed by the ingestion of substances which crystallise or precipitate to form a solid mass in the stomach, although ingested in a soluble form. The commonest examples are the shellac concretions found in painters and furniture workers (Inlow, 1940), the alcoholic solution of shellac being imbibed for the intoxicating effect of the solvent. Paraffin (Tondreau and Kirklin, 1950), starch (Brown and Schneider, 1951) and various inorganic salts have also been described as a cause of concretions.

Clinical Manifestations

Gastric bezoars, particularly trichobezoars, usually attain a very large size before producing symptoms severe enough to necessitate medical advice. Anorexia, indigestion, nausea and vomiting are the common manifestations, but the clinical picture is not specific, so that the lesion is seldom suspected clinically unless a gastric tumour is palpable and a history of hair swallowing is readily obtained. They usually occur in young females, who are frequently psychologically abnormal. Barium meal examination produces a diagnostic picture, the relatively radiolucent bezoars contrasting with the denser enveloping barium.

The commonest complications which may precipitate the clinical picture are gastric ulceration and intestinal obstruction. The second is more common with phytobezoars because they are smaller than trichobezoars and can pass into the small intestine more readily. It is the occurrence of such a phenomenon in an octogenarian female under treatment for myocardial infarction which prompted this report.

Case Report

A female, aged 79, was admitted to hospital with a clinical diagnosis of coronary sclerosis and myocardial infarction. Apart from typhoid fever when she was aged seven years, she had lived a healthy and active life until eight years prior to admission when she developed shortness of breath and anginal pain on exertion. These symptoms had progressively increased in severity but she was able to care for herself until five days prior to admission, when she collapsed with severe persistent anginal pain and sudden dyspnoea. She was treated at home with bed rest, analgesics and digitalis prior to admission.

When first seen she was not in any pain and appeared well-nourished. The pulse was irregular, due to auricular fibrillation, but of good volume, and the blood pressure was 130 millimetres of mercury systolic and 80 millimetres diastolic. The apex beat was palpable in the fifth left intercostal space four inches from the mid-sternal line. There was a dual rhythm and no bruits were audible. There was one inch of raised jugular venous pressure, fine rales

were heard at the base of the left lung and there was slight pitting oedema of the ankles.

An electrocardiogram taken on admission confirmed the presence of auricular fibrillation and revealed a left heart strain pattern with digitalis effect but not definite evidence of myocardial infarction. The patient was treated with bed rest, anticoagulant therapy, digitalis, mercurial diuretics and sedation.

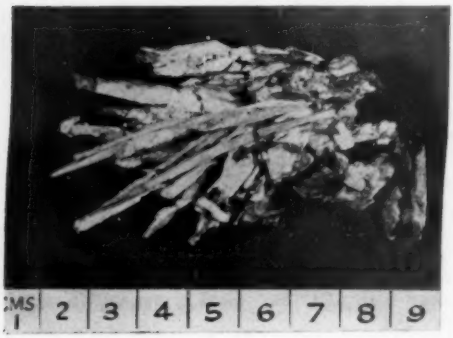

FIG. 1. The phytobezoar after drying out. The rolled up tomato skins are obvious. When first removed the mass was smoothly ovoid and covered with mucus.

Her post-operative course was uneventful. She was discharged to a convalescent hospital on the ninth post-operative day and at this time residual sacral oedema was the only clinical evidence of cardiac failure, which was controlled with digitalis and mercurial diuretics.

Progress was satisfactory until the thirteenth day after admission, when the patient began vomiting. There was no abdominal pain. She passed a constipated stool, the abdomen was not distended and bowel sounds were present. The next day the vomiting was more severe, producing foul-smelling material, the abdomen became slightly distended and she did not have a bowel action nor pass flatus.

X-ray examination of the abdomen revealed gas distended small bowel with fluid levels. Some gas was present in the large bowel. At this stage continuous gastric aspiration and intravenous fluid therapy was instituted. Within twenty-four hours the gastric aspirations became more copious, offensive and faeculent. The abdomen was more distended and repeated X-ray examination revealed increased distension of the small bowel with fluid levels but minimal gas in the large intestine. The appearances were suggestive of a partial small bowel obstruction due to a mechanical rather than a paralytic lesion.

At operation (Mr. James Guest), the jejunum was found to be moderately dilated for three feet distal to the duodenojejunal flexure, then of smaller diameter, but still somewhat dilated, for another foot, at which site its lumen was obstructed by an ovoid mass five centimetres in transverse diameter and seven centimetres in length. Below this obstruction the small bowel was of normal diameter for several feet and then completely collapsed to the ileocaecal junction. The whole of the large bowel was completely collapsed. The obstructing agent was removed through a longitudinal incision in the jejunum, which was closed transversely in two layers, and was recognised as a phytobezoar (Figure 1), consisting of pieces of tomato skin rolled into thin sticks and matted together with cellulose material, food, small bowel content and mucus.

DISCUSSION

The symptoms in this patient were remarkable because of the absence of pain, which is generally accepted as a necessary feature for the diagnosis of mechanical small bowel obstruction. To direct questioning concerning pain the patient's only complaint was abdominal discomfort associated with nausea and aggravated by vomiting. Consequently, the vomiting and abdominal distension were originally ascribed to either disordered bowel function secondary to electrolyte disturbance or mesenteric vascular thrombosis. Serum electrolyte estimations revealed a lowering of sodium and chloride concentrations (127 and 91 milliequivalents per litre respectively) and a blood urea of 115 milligrammes per centum. These changes were considered to be subsequent to and not causative of the bowel condition.

Mesenteric vascular thrombosis was considered the most likely cause of intestinal obstruction in an old person with severe myocardial damage and auricular fibrillation; the gradual development of the manifestations of obstruction in this case suggesting a venous rather than arterial thrombosis.

Radiography confirmed progressive dilatation of small bowel loops, and it was considered that laparotomy was indicated because the possibility of a removable mechanical factor causing partial small bowel obstruction could not be dismissed, in spite of the absence of colicky pain. It was fully realised that there may have been an extensive mesenteric vascular lesion. However, such a diagnosis can be confirmed only by laparotomy, and a circumscribed vascular lesion may be amenable to surgical treatment. Obstructive phenomena were progressing, in spite of conservative management for twenty-four hours, and deterioration in the patient's condition was attributable to the bowel lesion and not the cardiovascular state.

The laparotomy, which was the consequence of this reasoning, was extremely rewarding. A phytobezoar impacted in the jejunum was easily removed.

This bezoar consisted predominantly of undigested tomato skins and it was later discovered that the patient had consumed several raw, unskinned tomatoes while in hospital. The accident of digestion resulting in these becoming aggregated into an obstructing bolus is pure conjecture but the potential danger in administering excess indigestible vegetable fibre, particularly to a debilitated aged patient, is obvious.

Tondreau and Kirklin (1950) list sixteen vegetable substances reported to have constituted phytobezoars, ranging from wild beets to raisins, but do not mention tomato skin, which was the causative factor here and in at least one other case (Stewart, 1955).

It is of some theoretical interest that in the U.S.A., and Japan, where the persimmon is a native tree, the occurrence of bezoars due to this substance is relatively common. Experiments have shown that one of the components of the persimmon is precipitated into a gelatinous mass under the influence of the gastric hydrochloric acid.

The factors responsible for the formation of bezoars due to other vegetable substances are unknown.

SUMMARY

1. Bezoars are defined, classified and their clinical features briefly discussed.

2. A case of partial small bowel obstruction, due to a phytobezoar consisting of undigested tomato skins, is presented.

3. The diagnostic difficulties in this case, and pertinent theoretical considerations, are discussed.

ACKNOWLEDGMENT

I wish to thank Mr. James Guest, who performed the laparotomy and Mr. I. H. Cumming for his help in the management of the patient and preparation of this report.

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THE PHYSIOLOGY OF HYPOTHERMIA

By MARGARET MCCLELLAND

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THE search to make intra-cardiac surgery under direct vision a practical proposition has resulted in some ingenious developments. Hypothermia is only one of these but in spite of some disadvantages, it is the simplest of them all to carry out.

General hypothermia was first used about 1939 by Smith and Fay who cooled patients to 26°-28°C and maintained low temperatures for about 3-5 days — the longest recorded being 8 days. These patients were cooled to relieve inoperable malignancies, with some success and in a series of 175 patients, 2 died. Many other patients were treated in this way and the work was reviewed by Talbott in 1941.

During the war, Himmler instituted cooling experiments to discover a means of resuscitating airmen after immersion in the sea. Prisoners without any kind of sedation were put in a bath at 10°C. After about 10 minutes consciousness mercifully became clouded and was lost at 31°C or thereabouts. Death, when it occurred, was at 24°-26°C and was always cardiac in origin.

Some of the observations reported have been suspect, but many of them agree with those of Smith and Fay and also with more recent reports.

Briefly: Auricular fibrillation was a common event.

The blood viscosity increased and the haematocrit rose.

There was a significant rise in blood sugar and the urinary output was decreased.

In none of the human coolings so far reported has there been evidence of cerebral damage — a point of importance.

Electroencephalographic studies were made on monkeys which were cooled to 20°C (Callaghan *et alii*, 1954). The progressive diminution of wave forms suggests that cortical activity decreases as the temperature falls and in several monkeys there was no activity whatsoever at 20°C. No wave form suggesting anoxia were evident and the pattern returned in reverse on rewarming. The monkeys appeared quite normal and were able to perform their various tricks when they recovered.

Animal experiments

The bulk of our knowledge about hypothermia comes from animal experiments, but one must remember that organisms exhibit wide species variations, for example, some fish and bacteria can survive temperatures near absolute zero.

Cold-blooded animals as well developed as the frog can be frozen stiff for several months and will "come to life" again when they are rewarmed.

Hibernating animals make an interesting study because their body temperature may fall as low as the external surroundings, for example, 2°-3°C and at this stage the heart rate may be 5-10 beats per minute with a respiratory rate of 2.

During their active months, it is possible to cool these animals down to similar low temperatures and safely occlude the cardiac circulation for about 2 hours, after which the animals can be revived to normal.

Bigelow of Toronto, who was the first to suggest hypothermia as an adjunct to cardiac surgery, attributes this ability to survive low temperatures to special tissue, which histologically resembles the adrenal cortex, scattered through the mediastinum and in the axillae. He is making extracts from this tissue and thereby hopes to reduce temperatures in non-hibernating animals to safe low levels.

The effects of cooling

The effects of cooling have been studied extensively in the dog. It is now known that if an animal is anaesthetized and put in an ice water bath, certain reaction can be expected.

Breathing, after an immediate stimulation, soon becomes progressively depressed and will finally stop at temperatures of 22°-24°C. If at this stage respirations are controlled, then the animal may be taken to still lower temperatures — down to 18°-20°C — and death results from cardiac arrest or ventricular fibrillation. Shivering, which is the body's main defence against cold, will increase the oxygen consumption by 200-300 per cent and is avoided by deepening the anaesthetic.

If surgery is contemplated, the dog should be removed from the water at 30°C because a further drop of temperature can be expected.

This is a point of some practical interest. At the Royal Children's Hospital in Melbourne Mr. Russell Howard has operated on three children with cardiac conditions under hypothermia and Figure I represents the cooling curve of our first effort.

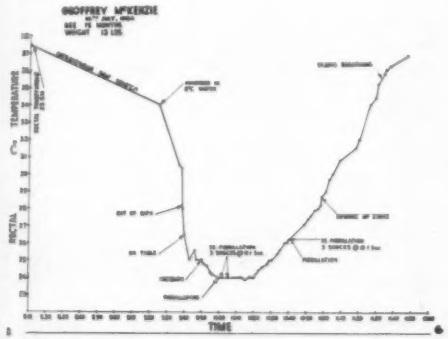

FIG. I. Graph showing temperature changes in relation to various operative activities in Case 1.

Case 1

The patient was a desperately ill undersized infant aged 15 months. The anaesthetic was rectal thiopentone after which an intravenous drip was begun and the child then intubated under *tubarine* and maintained with nitrous oxide and oxygen.

During the time taken to start the drip the temperature fell 2-3 degrees. We aimed to take the child out of the bath at 30°C but actually did so at 28°C. The temperature fell rapidly and was still falling when surgery began. Ventricular fibrillation occurred when the pericardium was opened and again later; the heart was defibrillated by electric shock on both occasions.

Rewarming was carried out with hot saline packs in the chest cavity and by running hot water into a bag on which the child was lying.

After diagnosing inoperable transposition of the great vessels, the operation terminated without further event and the babe died two days later from its condition.

Oxygen and cardiovascular changes

The oxygen and circulatory changes due to cooling are fairly consistent and well established (Bigelow, *et alii*, 1954). The blood pressure rises a little at first and then falls along with the heart rate, cardiac output and the temperature. Venous pressure is maintained during spontaneous breathing — but rises with controlled respiration and returns to normal when breathing is resumed again, as do the other changes during rewarming.

The oxygen consumption steadily declines with the fall in temperature, provided shivering is avoided and arterial oxygen saturation is maintained. At 30°C the oxygen consumption is 55 per cent. of normal and the blood pressure about 100 mm. Hg. At 25°C oxygen consumption is 33 per cent. of normal and the blood pressure 80 mm. Hg. and this, theoretically, should be a reasonable working level. At 20°C when the oxygen requirements are 15 per cent. of normal the blood pressure has fallen to dangerous levels. Temperatures in the region of 28°C should provide most of the surgical requirements with relative safety.

Ross (1954) states that, during cooling, the arterial and venous oxygen content of the blood is as much as 2 vols. per cent above normal, but even as low as 25°C the arteriovenous difference is within normal limits.

Oxygen does not dissociate readily at low temperatures but solubility in the plasma is increased and appears to be sufficient for the cooled tissue demands.

Cardiac action during hypothermia

The behaviour of the heart in response to cooling is undoubtedly the major stumbling block to the surgical application of hypothermia.

Cardiac slowing results from the direct effect of cold on the sino auricular node. Ross

(1954) describes a dog undergoing blood stream cooling in which the right auricle was arrested while the heart continued to beat.

The coronary blood flow must be disturbed by the fall in blood pressure and also by the prolonged contraction of the cold heart. Seventy per cent of the cardiac cycle is spent in systole which leaves a relatively short diastole for adequate filling and the nutrition of the heart.

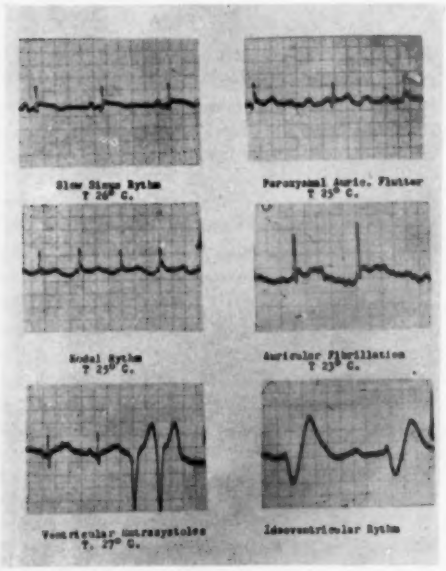

FIG. II. Electrocardiograms showing features at various temperatures.

Electrocardiogram changes show a characteristic pattern — and these include delayed conduction time, with a widening of the QRS complex, elevation of the ST segment, and inversion of the T wave.

Various disturbing irregularities may appear at any stage of cooling. Auricular fibrillation occurs early. Ventricular extrasystole, heart block, ideoventricular rhythm will precede cardiac arrest or ventricular fibrillation.

Swan *et alii* (1953) describe a series of patients, mostly children, who were cooled for various procedures, and of these 7 developed auricular fibrillation. There were 3 cases of cardiac arrest and one ventricular fibrillation which was reversed. One case of arrest went into fibrillation and the child died — making one death in 15 patients.

Figure 2 demonstrates a succession of cardiac irregularities in the second child that we cooled, in a fashion similar to the first.

The babe was 7 months old, suffering severely from Fallot's tetrad with infundibular stenosis.

The cardiac circulation was occluded for precisely 5 minutes during which time the right ventricle was opened, the stenosis relieved, the heart filled with saline and the ventricle closed.

Unfortunately air became evident in the coronary vessels when the circulation was restored and the heart which had beat feebly during the cardiotomy now developed slow ideo-ventricular rhythm which resisted all efforts of resuscitation.

In a more recent venture a child aged 9 years was cooled by the blanket technique and the temperature readily controlled at 27°-28°C. The cardiac circulation was occluded for 4 minutes, during which time a pulmonary valvular stenosis was dealt with through the pulmonary artery. The child was awake and crying when the temperature reached 36° and there was no evidence of cerebral damage when he fully recovered.

Blood chemistry

In studying the problem of cardiac arrest and ventricular fibrillation, changes in the reaction of the blood and of certain electrolytes are of basic importance — in particular potassium and calcium. Broadly speaking:

Potassium is necessary for the synthesis of acetylcholine and in excess it will stop the heart in diastole.

Calcium in excess increases the force of the heart and stops it in systole.

Reports on this subject are conflicting, but one of the most convincing comes from McMillan (McMillan *et alii*, 1955), at the Buckston Browne Research Farm. Cooling depresses breathing which leads to CO_2 retention and acidosis. Associated with this is an increase of calcium and a slight rise in potassium. Overventilation produces alkalosis which is associated with only a small increase in calcium and fall in potassium. The Ca/K ratio is disturbed in both groups but less so

with overventilation and alkalosis; a disturbed balance between these ions must adversely affect the heart.

If one considers also the changes in cardiodynamics, along with surgical manipulation, and add to this complete occlusion of the circulation, followed by the insult of cardiotomy — it is little wonder that cardiac disturbances occur.

Ventricular fibrillation and cardiac arrest

Ventricular fibrillation when it occurs is a disturbing experience to most of us but less so to some. Lewis and Taufic (1954) are so sure of their ability to defibrillate the dog's heart that, when operating through the atrium to close a septal defect, they deliberately induce ventricular fibrillation and thereby obtain a quiet field for operation and reduce the risk of coronary air embolus. Their method of defibrillation is a sequence of cardiac massage, intracardiac adrenalin and serial electric shocks.

Swan (Swan *et alii*, 1953), who has a large number of coolings to his credit, advocates the injection of potassium chloride into the coronary arteries, because the serum potassium is low and also there is a large outpouring of potassium from the fibrillating myocardium. Following the injection with massage, arrest in relaxation should result. If further massage does not restore the heart beat, then minute doses of calcium chloride should be effective.

It is worth remembering that calcium chloride precipitates ventricular fibrillation in a digitalized heart at normal temperatures and will probably do the same at low temperatures.

Swan has successfully defibrillated dogs' hearts with acetylcholine and prostigmine, which acts by destroying the antagonists of acetylcholine. In his recent operations, he attributes the absence of ventricular fibrillation to the prophylactic use of prostigmine. Bigelow *et alii* (1954), also have considered the advisability of using this drug.

Probably the most universally successful method of reversing ventricular fibrillation is the use of an electrical defibrillator. When combined with cardiac massage, which will produce a blood pressure of 60-80 mm. Hg. if effective, efforts to restore the heart to normal may be carried out for a considerable time.

Cardiac arrest presents another formidable problem yet to be solved. The electrical pacemaker has not produced uniformly good results (Stephens *et alii*, 1954).

In the search to give the surgeon a longer time within a quiet heart at lower temperatures, some interesting experiments have been performed (Niazi and Lewis, 1954). A group of 20 dogs were cooled breathing 5 per cent CO_2 in O_2, and at 20°C the CO_2 was removed so that they continued breathing O_2 alone. The temperature of half of these dogs fell to 12°C or lower by which time the heart stopped beating. After 1¼ hours in arrest, they were rewarmed and 80 per cent of them recovered without ill effects.

Of the other half, the temperature of some fell to 0°C with the heart still beating while others fibrillated near 16°; all this group died during rewarming.

There appears to be a critical temperature at which the sudden change in the blood's reaction from acid to alkaline leads to cardiac arrest or ventricular fibrillation.

A more promising study of elective arrest comes from Melrose *et alii* (1955). They perfused the coronary arteries with potassium citrate, thereby producing a still flabby heart which facilitated surgery and the expression of air when the ventricles were closed. The heart beat was restored when the coronary vessels were perfused under pressure with oxygenated blood.

In another experiment (Schafer *et alii*, 1955), dogs were cooled until the ventricles fibrillated at temperatures of from 27°C down to 13°C and they were allowed to remain chilled for periods up to 5 hours, after which resuscitation was attempted.

Their method of resuscitation is noteworthy. Rewarming was begun — the chest opened and effective cardiac massage performed and a single electric shock of 200 volts was given

at every degree rise in temperature until the heart action was restored. In this way dogs which had fibrillated for up to 60 minutes could be revived without evidence of damage.

These experiments are not at present directly applicable to human patients but they make a fascinating study and serve to indicate some of the problems that lie ahead of us.

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A METHOD FOR DETERMINATION OF THE RATE OF TRANSFER OF I^{131} ACROSS THE HUMAN COLONIC MUCOSA

By R. A. Joske and Edna V. Sherriff

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DETAILED knowledge of the function of the small bowel of man is scant, although studies have been made of alimentary function in the malabsorption syndrome (Fairley, 1930; Saint and Weiden, 1952) and following massive resection of the small bowel (Althausen *et alii*, 1950; Jackson and Linder, 1951a and b; Linder, Jackson and Linder, 1953). The present paper reports a method used for the determination of the rate of transfer of I^{131} across human colonic mucosa, which may also be used to study similar problems using other radio-active isotopes. I^{131} is selected because in Australia it is the most accessible of the suitable isotopes. This method consists basically of instilling a known amount of I^{131} into an artificial Gilchrist bladder of right side of colon and terminal ileum and performing a balance study over the succeeding hour. The surgical technique and results have been described previously (Godfrey, 1954). Somewhat similar studies have been reported in dogs by Marucci *et alii* (1954) and in man by Reed and Care (1954).

Method

After pelvic exenteration and construction of the Gilchrist artificial bladder the patient remains with a defunctioned loop of ileum and right colon into which both ureters are implanted.

Immediately prior to the administration of the dose the artificial bladder is drained and rinsed with saline. Forty μc of iodine-131 as NaI^{131} carrier free is introduced per catheter, followed by saline to a total of 40 ml. Fifty minutes after the introduction of the I^{131}, serial neck and thigh counts are begun, following the technique used in thyroid tracer studies (Clarke and Aujard, 1954). This counting is continued for 20 minutes at which time the "bladder" is drained and rinsed. A further count is taken over the thigh to give a measure of the contribution to the thigh counting rate of the pool of I^{131} in the "bladder." This corrected thigh counting rate is used to correct the neck counts for I^{131} in the neck tissue, when determining the thyroid content of radio-active material.

The drainings from the "bladder" are retained for assay. Sixty minutes after the initial administration of the dose, a 10 ml blood sample is taken for whole blood I^{131} assay.

Five studies on two patients with a colonic "bladder" were made. Three subjects with no detectable lesion of the kidneys or bladder were used as controls, the same method being employed.

Calculations

The total I^{131} content of the thyroid gland 60 minutes after administration can be calculated from the serial thyroid and thigh counts (Clarke and Aujard, 1954). The kinetics of I^{131} metabolism described by Myant *et alii* (1950) and by Ruegamer (1953) has been used in the calculations. An iodine space of 18 litres is assumed. The total iodine content of the body fluids at one hour is then determined from the total blood activity.

Assuming that the loss of I^{131} from the "bladder" is exponential, the amount present at one hour can be calculated from that recovered at 70 minutes after administration. The mean net loss of I^{131} from the "bladder" is then calculated.

TABLE 1

	Colonic Bladder					*Normal Bladder*		
	Case 1 (colonic bladder operation 21.12.53)			*Case 2 (colonic bladder operation 21.1.55)*		*Case 3*	*Case 4*	*Case 5*
Date of test	21.12.53	15.2.54	25.5.55	10.3.55	1.6.55	4.8.55	11.8.55	15.9.55
Dose administered (μc)	97	41	42	37	41	41	41	36
I^{131} in blood (μc/ml) $\times 10^3$	1.73	1.18	0.30	0.71	0.36	0.08	0.10	0.00
I^{131} " " (% dose/ml) $\times 10^3$	1.78	2.28	0.71	1.9	0.88	0.20	0.24	0.00
Average net rate of loss from bladder (% dose/min)	0.64	0.34	0.42	0.83	0.57	0.20	0.09	0.00
Average rate of accumulation in blood and thyroid (% dose/min)	0.59	1.00	0.31	0.72	0.35	0.06	0.08	0.00
At 1 hour								
I^{131} recoverable from bladder (% dose)	61	78	74	47	68	90	95	100
I^{131} in thyroid (% dose)	5	4	3	8	4	0.3	0.4	0.0
I^{131} in total iodine space (% dose)	32	52	13	35	16	3.5	4.5	0.0
Total I^{131} accounted for (% dose)	98	134	90	90	88	94	100	100

RESULTS AND COMMENTS

The results in the test cases and controls are shown in Table 1. The discrepancies in the total iodine accounted for (vide Case 1) can be understood when it is recalled that the total iodine space was assumed to be 18 litres in all cases.

Although these results are still preliminary, even at this stage it may be stated that the present method is practicable and gives reasonably consistent quantitative results, and that the ionic uptake appears to be very much greater from the artificial colonic bladder than from normal bladder mucosa. Further investigations are proceeding to determine the effects of deep X-ray therapy upon ionic uptake from the colonic bladder.

ACKNOWLEDGEMENTS

This problem was raised by Mr. Graham Godfrey, Gynaecologist, and Dr. W. P. Holman, Honorary Radiotherapist, of the staff of the Royal Women's Hospital, who have given their support and encouragement to the development of the method.

Thanks are due to Dr. C. E. Eddy, Director of Commonwealth X-ray and Radium Laboratory, and Dr. Ian Wood, Head of the Clinical Research Unit of the Royal Melbourne Hospital and the Walter and Eliza Hall Institute, for encouragement in the work.

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INTESTINAL OBSTRUCTION CAUSED BY A SUB-MUCOUS HAEMATOMA IN THE TERMINAL ILEUM

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MECHANICAL obstruction of the small intestine due to an intra-mural haematoma seems a sufficiently rare condition to warrant its being put on record.

REPORT OF THE CASE

H.I., a thin male child, aged 8, was admitted to hospital on 7th August, 1955, with a ten-hour history of a colicy, central abdominal pain. He was treated conservatively but, on the following day, was considered to have a subsiding mild appendicitis. In view of the history of recurrent abdominal pain for over a year, it was decided that his appendix should be removed.

A routine appendicectomy was performed on 8th August, 1955. The appendix was thought to be mildly infected and the omentum was lightly adherent to its tip (later the appendix was found to be normal histologically).

In view of the inconclusive findings a search for some other pathological condition was made, during the course of which the lower few feet of the ileum were examined. Apart from the finding that the pelvic colon and rectum were loaded with faeces, no abnormality was found.

The appendix was removed, the stump buried by the purse string technique, and the abdomen closed.

Following operation the child did not prosper. He was lethargic and vomited occasionally, but there was no rise in temperature.

His abdomen was examined on several occasions and was found to be soft with bowel sounds present.

On the fifth post-operative day, the child vomited and began complaining of colicy central abdominal pain. The temperature and pulse were normal. Distended loops of bowel were now obvious in the right hypochondrium and the bowel sounds were tinkling in nature. An X-ray revealed numerous distended loops of small gut and many fluid levels. A diagnosis of acute small gut obstruction was made.

An enema which produced a good flatus result gave temporary relief. A Miller-Abbott tube was passed and intravenous fluids begun.

By the eighth post-operative day it was obvious that the child's condition was deteriorating. He was experiencing severe colicy abdominal pain and the abdomen was distended and tympanitic. On the evening of the eighth day the abdomen was re-opened through a right lower paramedian incision. A small amount of free blood-stained fluid was aspirated and the purse string area on the caecum found to be clean.

Approximately 25 cm. above the ileo-caecal junction the ileum was black and tense over a length of approximately 14 cm. The mesenteric vessels leading to this part of the gut were patent. Above the affected area the bowel was distended and contained thin fluid and gas. The affected portion of the ileum was removed and the bowel reconstituted by a side to side anastomosis. The wound was then closed.

On sectioning the removed portion of ileum, it was found to contain a large submucous haematoma which completely obliterated the lumen. Around the edges of the haematoma there was evidence of early organisation.

Following his second operation the child showed progressive improvement but suffered for the first few days from intestinal colic. The wound healed well and he was allowed home some two weeks later.

Just before discharge a blood pressure reading was systolic, 118 mm. Hg., and diastolic, 80 mm. Hg., a Hess's test was negative, and the bleeding and coagulation times were 1½ and 8½ minutes respectively.

DISCUSSION

The cause of a rupture of a vessel in the wall of the ileum remains uncertain. It must have occurred during or following the handling of this section of the bowel at the time of the appendicectomy, but no undue force was used then. Again there was no evidence to suggest that this section of bowel became involved in any of the suturing. It seems probable that an unusually fragile vessel was ruptured during a routine examination of the bowel. Routine tests showed no abnormal bleeding tendency.

ACKNOWLEDGEMENT

I wish to thank Mr. G. F. Rich for permission to record this case.

Books Reviewed.

SURGERY OF THE SMALL AND LARGE INTESTINES.
By CHARLES W. MAYO. Illinois, U.S.A.: Year Book Publishers, Inc., 1955. 8¼" x 5¼", 340 pp., 94 illustrations. Price: $9.00.

This very practical small book deals with many of the lesser problems of practical management in the surgery of the intestines and in many instances discusses the operative details and post-operative management in a very helpful way. The illustrations are profuse but many of them do not merit inclusion and in some instances the illustrations do not convey the points made in the corresponding text. No attempt is made to discuss problems in any detail and the author clearly sets out to give his own practice in clear, brief fashion. This is not a book which will replace the standard volume on the subject.

THE CASUALTY DEPARTMENT.
By T. G. LOWDEN, M.A., B.M., F.R.C.S. Edinburgh: E. and S. Livingstone Ltd., 1955. 9¾" x 6¾", viii plus 278 pp., 170 illustrations, 12 in colour. Price, 37s. 6d. net.

The organization of the Casualty Department in General Hospitals and the method of rostering junior house surgeons for duty without the supervision and guidance of one of the senior members of the staff leave much room for improvement. The author of this valuable book gives the reader the benefit of his seven years experience in a well-organized Casualty Department where methods of treatment and results have been critically analyzed.

The text is clear, the methods of treatment sound and the numerous illustrations excellent. Case histories emphasize the management of typical problems.

The first part of the book deals with the common septic conditions requiring treatment. Antibiotic therapy is placed in its correct perspective in relationship to surgery. At the same time it is shown how some standard surgical procedures can be modified in the presence of an antibiotic cover.

The second part discusses the commonly occurring minor surgical conditions. Fractures are excluded.

In the third part chapters are devoted to "Organization," "Financial and Temperamental Background," "Legal Responsibilities" and "Legal Protection." The introduction of these neglected subjects in the standard textbooks is well worthwhile, and should be an essential part of the training of every practitioner.

This book can be strongly recommended to house surgeons, general practitioners and consultants.

LOCAL ANALGESIA HEAD AND NECK.
By Sir ROBERT MacINTOSH, D.M., F.R.C.S.(Edin.), F.F.A.R.C.S., and MARY OSTLERE, M.B., M.R.C.P.E., F.F.A.R.C.S. Edinburgh: E. and S. Livingstone Ltd., 1955. 9" x 6", 130 pp., 145 illustrations. Price: 27s. 6d. net.

This book of 130 pages is divided into two almost equal parts. The first part describes the anatomy of the sensory nerves and of the sympathetic and autonomic nervous systems of the head and neck. The description is lucid, accurate, well illustrated and all extraneous matter has been omitted. The second part of the book deals with the technique of obtaining analgesia for certain head and neck operations such as Tonsillectomy, Ophthalmic Operations, Dental Surgery, and Surgery of the Nose and Para-Nasal Sinuses. The directions given are clear and the text is well illustrated.

This book will be of value to those surgeons and anaesthetists interested in local analgesia for certain operations on the head and neck and it will provide a useful background whilst skill in these procedures is being acquired in the operating room.

MODERN PRACTICE IN ANAESTHESIA.
Edited by FRANKIS T. EVANS, M.B., B.S., F.F.A.R.C.S., D.A. Second Edition. London: Butterworth and Co. (Publishers) Ltd., 1954. 10" x 6½", xv plus 622 pp., 221 illustrations.

This volume is the work of twenty-six authors and accordingly varies in quality from chapter to chapter. In this, the second edition, some of the weaknesses of the first have been eliminated by the complete revision of chapters. As the result of this some names have disappeared from the list of contributors and others have appeared in their places. Additional chapters on such subjects as "Controlled Hypotension" and "Fires and Explosions" have been added.

In this edition there are still strange statements such as "Hewitt's wide-born modification (of the Clover inhaler) still enjoys wide popularity and is in constant use by many practitioners all over the world." It would appear that the author of this section has failed to modify the text over the last twenty years. In the section on neuro-surgery, we read that "induction of anaesthesia is carried out with thiopentone 0.4 gramme and curare 15 milligrams." Presumably, tubo-curarine is meant.

A new chapter on the Physiology of Respiration provides a brief summary of the subject. It, however, fails to discuss Diffusion Anoxia which has received considerable attention in recent years.

In the text dealing with nitrous oxide anaesthesia anoxia is condemned but the author then describes nitrous oxide-air administration and talks of slight cyanosis. These two statements are not compatible. In the same chapter it is stated that "cyclopropane is used as a routine for major lung operations in conditions such as tuberculosis and bronchiectasis." This anaesthetist cannot have heard of the earnest desire on the part of the thoracic surgeon to employ the endotherm.

Two chapters on "The Principles of Muscular Relaxation" and "The Relaxants" have been contributed by T. Cecil Gray and have been brought as up to date as is possible with any major publication.

In the discussion on anaesthesia for thymectomy, it is still recommended that neostigmine should be administered before the induction of anaesthesia. Surely, it is rational to leave this until the operation has been concluded.

This volume provides a satistactory text for a person wishing to obtain information on anaesthesia for certain operations but some of the basic material could be misleading.

Taking into consideration the difficulties of multiple authorship, the editor has performed a satisfactory task. The type font has been changed and the paper is of better quality so that reading is more pleasant than in the first edition.

NEURO-VASCULAR HILA OF LIMB MUSCLES.
By JAMES COUPER BRASH, M.C., M.A., M.D., D.Sc., LL.D., F.R.C.S.(Edin.), F.R.C.S.E. Edinburgh: E and S. Livingstone Ltd., 1955. 9½" x 7½", xvi plus 100 pp., 30 illustrations. 30s. net.

This book is an atlas of 100 pages and it contains 30 coloured plates. The object of this work is to describe and illustrate the precise anatomy of the nerve of supply to the various limb muscles (excluding the intrinsic muscles of the hand and foot) and to determine the extent to which the principal blood supply is associated with the nerve, that is, the constancy or otherwise of a definite "neuro-vascular hilum."

The common method of nerve supply to each muscle is described and illustrated and the possible positions of nerve-entry are expressed as a percentage of the total number of dissections performed to obtain the necessary data, viz.:

Muscle . . . . . Brachioradialis.
Position of nerve-entry.
Above the level of the lateral epicondyle $20/29 = 69.0\%$
About the level of the lateral epicondyle $6/29 = 20.7\%$
Below the level of the lateral epicondyle $3/29 = 10.3\%$

A scale is drawn beside each plate so that the average levels of origin of motor nerves from main trunks and of their entry into muscles may be read off in relation to the bony landmarks selected.

The figures obtained for the position of nerve-entry are compared with those of previous workers in this field. This book therefore provides a valuable work of reference for those who desire a knowledge of the precise method of nerve and vascular supply in the limb muscles and it will be particularly valuable to those surgeons whose interest is in the treatment of peripheral nerve and vascular injuries.

Vol. II, No. 3. BRITISH MEDICAL BULLETIN. (Surgery of the Heart and Thoracic Blood Vessels).
By 21 Contributors. London: Medical Department, The British Council, 1955. 11¼" x 8¾", 71 pp., 55 illustrations.

This number has been compiled by a panel of British authorities who present a well-balanced statement on the place of surgery in the treatment of disorders of the heart and thoracic blood vessels.

The criteria for the selection of patients suitable for surgical treatment are stated in papers by Maurice Campbell and Paul Wood. A. I. Parry Brown and B. A. Sellick contribute an authoritative paper upon the anaesthetic requirements for cardiac surgery.

Mitral stenosis, patent ductus arteriosus, pulmonary stenosis and coarctation of the aorta are conditions in which operative treatment is of proven worth, and they are dealt with at length by Sir Russell Brock, E. A. Mason, O. S. Tubbs and T. Holmes Sellors.

Aortic valve disease, mitral regurgitation and septal defects are discussed briefly, and in each instance it is shown that much work must yet be done before surgical methods can become standardized.

The cardiac surgeon hopes that ultimately he will be able to operate inside the still, dry heart. A vast amount of experimental work is being directed towards this end and the results that have been achieved so far are indicated in articles on hypothermia by E. J. Delorme and D. N. Ross, on cross-circulation by A. T. Andreason, and on artificial heart-lung machine by W. P. Cleland and D. E. Melrose.

It is important that every surgeon and anaesthetist should know what to do when confronted with a cardiac arrest. The article by I. K. R. McMillan on cardiac resuscitation states the position clearly and it is highly recommended.

The treatment of coronary artery disease has not been dealt with in this publication. A well-argued paper upon this controversial subject would have been a useful addition.

TRANSPLANTATION OF TISSUES (Vol. I).
By LYNDON A. PEER, M.D. First Edition. England: Bailliere, Tindall and Cox Limited, 1955. 10" x 6¾", xii plus 422 pp., 163 illustrations. Price: 102s. 6d. net.

This book, the first of two volumes, on transplantation of tissues, deals with the transplantation of cartilage, bone, fascia, tendon and muscle. This describes work done by the author and reviews much of the literature and, indeed, it is this extensive review that makes it a significant and useful contribution to the subject.

The presentation of material is intended for the physician, surgeon and medical student. While the clinician will find a great deal of value in the statements and opinions in the book, the student should regard very much of it with caution.

The introductory chapters on the origin and nature of tissues are too brief and superficial to be really valuable though they can be regarded as a light "curtain-raiser" for the remainder of the work. The discussions on methods of examination and the general histological forms of tissues are also rather too sketchy to be of value to the student. A good deal of relevant work of the last few years has been overlooked and not included.

When it comes to the actual matter of grafting, however, the text adopts a different form. There is a great deal of information carefully divided into various sub-sections according to whether the grafts are autogenous, homogeneous or heterogeneous. The differences between embryonic and adult tissues are clearly stated and the effects of various types of stimuli on grafts are discussed. In most parts, the results of animal experiments are given.

One of the valuable contributions in the book is the discussion of the two hypotheses of grafting described as the "cell survival theory" and "replacement theory." The author attempts a balanced assessment of the two views, but it is clear that he is wholeheartedly in favour of the cell survival hypothesis. A great deal of the evidence that he

brings forward for special cases is indisputable, but there is much more which will be quite unacceptable to most biologists. His enthusiasm has caused him to make wide assessments and unjustified deductions from incomplete observations which have other interpretations.

At the same time, the material is interestingly and well presented, in considerable detail. There are numerous valuable references to the literature, particularly on the technical side and should receive careful study.

The volume is well produced on heavy art paper and there are numerous illustrations—partly photomicrographs and partly drawings. Many of the drawings are oversimplified but, provided the inherent fallacies in some of them are appreciated, these can be most useful. The bibliography given at the end of each chapter is an extremely useful adjunct.

Thus, with the *proviso* that the student should accept the observations but be rather sceptical about some of the hypotheses (and after all, this should apply to all books), this is a volume which is thoroughly recommended.

FRACTURES OF THE FACIAL SKELETON.

By N. L. ROWE and H. C. KILLEY. (Foreword by Sir Reginald Watson-Jones.) Edinburgh: E. and S. Livingstone Ltd., 1955. 9½" x 7", xxxvi plus 923 pp., 1,231 illustrations (14 in full colour). Price: £6 net.

This "monumental" work, as it is described by Sir Reginald Watson-Jones in his foreword, represents the consolidation of many years of experience of facial injuries both in peace and at war at one of the foremost training grounds for maxillo-facial surgeons in England. It is, therefore, authoritative and will command the immediate respect of all interested surgeons throughout the world.

The authors have been at great pains to include everything even remotely related to the main subject in an attempt to make it the complete reference book not only on facial fractures, but also on all possible associated conditions. In so doing they have had to enlist the aid of experts in other fields and have added enormously to the size of the book, bringing it out of the price range of many individuals and into the class of massive reference works which, for the most part, are found only in the medical libraries.

Part I deals with fractures of the mandible with the emphasis in the treatment section on the use of indirect methods of fixation. The uses and techniques of interdental wiring and of cast metal splints where teeth remain on the fragments are elaborated and excite no other criticism than that the condemnation of open cap splints indicates no more than a lack of experience with a type of splint which is widely and successfully used in many other units in preference to the more cumbersome splints that the authors advocate. In dealing with edentulous fragments, however, the authors have listed a profusion of technical methods which are surely of little more than historical value as primary methods of treatment to-day. The conservatism which commits a patient to any of the clumsy and often tedious methods of fixation listed by the authors when through a small incision a metal plate or wire can be applied directly to the bone, reducing post-operative management to a minimum, simply reflects the difference between the dental and surgical approach to these problems. It is a pity that in a work of this nature no lead is given to the reader who is seeking the simplest and best method among a lot of alternatives.

Part II deals with middle third fractures and here perhaps the only major criticism that may be levelled is that the authors have failed to take advantage of a golden opportunity to simplify an already complex and unwieldly classification. When one starts to talk about "lateral middle third fractures," surely it is time to take stock of one's terminology!

The latter portion of the book is devoted to useful sections on war wounds, anaesthesia, secondary procedures for established deformities, technical laboratory methods and the management of related injuries.

Although one cannot help the feeling that this book has grown almost beyond control in the preparation, it is, nevertheless, beautifully produced throughout, and is an important contribution to surgical literature.

Books Received.

ALFRED HOSPITAL—CLINICAL REPORTS. (Volume V.)

By Sundry Authors. Australia: Messrs. Brown, Prior, Anderson Pty. Ltd., 1955. 10" x 6", 125 pp., 46 figures, 20 tables.

ANALGESIA FOR MIDWIVES.

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